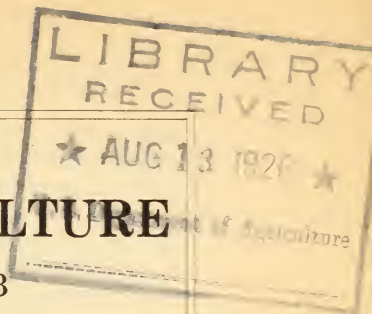


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### INDUSTRIAL OUTLETS FOR SHORT-LENGTH SOFTWOOD YARD LUMBER

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#### THE PROBLEM OF SHORT-LENGTH DISPOSAL

In the manufacture of softwood yard lumber large quantities of short-length lumber now go to waste outright or are so used as to yield but a fraction of their real value. In the movement for better utilization of the Nation's diminishing timber supply the salvaging of this material is a problem of no mean importance. The purpose of this circular is to discuss the possible development of more adequate outlets for these short lengths.

Short lengths, as here considered, are lengths under 8 feet. Actually they consist largely of 4 and 6-foot material, because rela-

tively little odd-length lumber is manufactured and relatively little lumber shorter than 4 feet is salvaged, but the classification includes also ready-cut stock of any length up to 8 feet. The short lengths produced at the sawmill occur as rough square-edged pieces and result largely from taper and crook in the logs. In the planing mills shorts are produced in dressed boards, or in worked lumber such as flooring, chiefly by cutting out serious defects in order to maintain grades in accordance with good manufacturing practice.

The waste of short lengths occurs because most consumers prefer long lengths or because they have difficulty in getting short lumber adapted to their particular needs. The building trade is accustomed to buying long lengths, despite the fact that fully one-third of the lumber must eventually be cut into short pieces for its intended use. The wood-fabricating industries also prefer long material, although less than one-third of their lumber is used in lengths of 8 feet or more. It might almost be said that the common demand is for long lengths to be cut into short lengths. Part of this preference for long lengths undoubtedly comes from trade custom, but some of it is due to practical difficulties and to slowness on the part of the lumber producer in catering to markets for short lengths.

#### **SURVEY OF FACTORY USES FOR SHORT LENGTHS**

In an endeavor to improve the correlation between the short lengths produced at the sawmills and planing mills and those demanded by the consumer, and in response to a request by the lumber trade for specific information that would aid in determining how short lengths should be dealt with in the newly established American lumber standards, the Forest Products Laboratory has conducted a study of the industrial or factory uses for short lengths of softwood lumber.

The use of short lengths in the building trade was not covered in the study, but the fact must not be lost sight of that constructional uses must absorb their quota of the short lengths. Indeed the building trade offers the largest single outlet for short lengths, particularly of worked lumber such as flooring, siding, and ceiling. The practice of end matching will undoubtedly have a far-reaching effect in overcoming the objections to the use of short lengths in certain items in building construction. End-matched softwood flooring and ceiling now have a recognized place in the market, and in the South at least two items, drop siding and concrete form material, are occasionally end matched. Such developments in manufacturing methods merit the active support of distributors and users of wood.

Special attention was given in the study to short-length worked lumber, its present and possible uses, for the reason that the disposal of worked short lengths is the most pressing part of the problem. Some attention was also given to square-edged material, but because of limitations of time and money the more detailed study had to be confined to worked short lengths.

Information gained through previous studies of the lumber requirements of wood-using industries enabled the laboratory to select certain industries as present or possible users of worked shorts. Additional industries and uses suggested themselves in the course of the field work. A study of each was made by personal canvas of



several representative factories and by communication with others through letters and questionnaires. A substantial part of each of the selected industries was thus reached, though owing to the limitations already mentioned no complete inventory of any industry was attempted. It is believed that, in the cases in which estimates of requirements have been made, the basis is reasonably accurate.

A canvass was also made of the distribution of softwood lumber through wholesalers and retailers. This included the collection of data on the quantity of lumber sold to industries and to the building trade, and on the uses for which it was purchased, the items purchased, and the proportion of lengths under 8 feet. This part of the study was based on answers to questionnaires from yards located mainly in the eastern half of the country. Although the returns represent only a small fraction of the trade as a whole, they are thought to reflect general conditions fairly closely.

In presenting the results of the survey it has been found convenient to group the data on (1) wood-fabricating industries studied most intensively; (2) uses of softwood yard lumber which require largely square-edged lumber and on which only general data were obtained; (3) industries using wood incidentally and designated as "nonwood industries;" and (4) distribution of softwood yard lumber by wholesalers and retailers.

The survey dealt with the use annually of 858,000,000 board feet of softwood yard lumber by 18 wood-fabricating industries, chiefly those that use softwoods in considerable quantities. This 858,000,000 feet constitutes 56 per cent of all softwood lumber used in the manufacture of wooden factory products exclusive of boxes and crates, millwork, and railway cars. It includes practically all the lumber bought by wood-fabricating industries in standard items worked to pattern.

Data were collected also on the use of nearly 5,000,000,000 board feet of softwood lumber annually for industrial or commercial purposes offering less promising outlets for short lengths of worked items than the 18 wood-fabricating industries; the use of approximately 210,000,000 board feet of softwoods annually by 53 large industrial concerns whose principal raw material is not wood, and the distribution of an undetermined quantity of softwoods by 76 wholesalers in 24 States and 493 retailers in 15 States.

#### INDUSTRIAL USE OF SHORT LENGTHS

The survey made by the Forest Products Laboratory indicates that industrial consumers are now purchasing short lengths in considerable quantities and may be looked to as potential buyers of three times the present quantity.

Of equal importance to the lumber producer is the indication that short lengths sold to the industries as ready-cut stock bring a price more on a parity with the price of long lengths than do short lengths sold for building construction.

#### INDUSTRIES STUDIED IN GREATEST DETAIL

The 18 wood-fabricating industries that were studied in the greatest detail as outlets for short lengths are listed in Table 1 along

with data as to the quantity, form, and sizes of softwood lumber consumed by each. This group, it is believed, contains practically all the important industrial uses for lumber that is customarily bought worked to standard patterns. The yard lumber purchased in lengths under 8 feet by these industries amounts to 118,000,000 board feet, or 13.8 per cent of their total softwood requirements. The softwood lumber that they finally use in lengths under 8 feet amounts to 595,000,000 board feet, or 69 per cent of their requirements.

It is estimated that these industries collectively might reasonably be expected to increase the percentage of short lengths in their total purchases of yard lumber from 13.8 to 45 per cent. This estimate takes into consideration: (1) The percentage of lumber now purchased in short lengths; (2) the percentage of lumber cut into short lengths after purchase; (3) the percentage of short lengths now being bought as such by the concerns using the largest proportions of short lengths; and (4) practical difficulties tending to make the use of shorts more or less undesirable.

The potential absorption of shorts of square-edged softwood yard lumber is much greater than that of lumber worked to pattern, both in volume and in proportion to quantity available. The following table gives a classification of softwood yard lumber of both forms (exclusive of box) used by the 18 wood-fabricating industries that were studied (see also Table 1):

Form of lumber	
Square-edged:	Per cent
Rough (mostly 1-inch)-----	27.2
Dressed (mostly 1-inch)-----	25.4
Dimension (mostly 2-inch)-----	19.5
Worked to pattern:	
Dressed and Matched-----	11.0
Siding-----	6.3
Flooring-----	3.7
Ceiling and partition-----	3.5
Other-----	3.4

#### INDUSTRIAL USES FOR WHICH ONLY GENERAL DATA WERE OBTAINED

Wood-using industries whose raw material is largely square-edged lumber were studied less intensively than those offering outlets for a considerable quantity of short lengths worked to pattern. Table 2 presents data on quantity, form, and sizes of softwood yard lumber required for 13 industrial or commercial uses which require largely square-edged lumber and concerning which only general data were obtained in the survey.

#### USE OF SHORT LENGTHS BY NONWOOD INDUSTRIES

Large potential outlets for short lengths exist in the industries which use wood incidentally or not as the chief raw material, designated in this circular as "nonwood industries." Their principal demand is for square-edged material for boxing and crating, machinery skids, and blocking.

The laboratory's very limited survey of these industries, summarized in Table 1, indicates that 37 per cent of their softwood yard

lumber requirement is purchased in specified lengths less than 8 feet, mostly as shooks, whereas about 85 per cent is actually used in such lengths.

DISTRIBUTION OF LUMBER

Sawmills now supply 87.4 per cent of the yard lumber used by wood-fabricating industries, wholesalers 11.4, and retailers 1.2.

Of the total yard lumber requirement of the other industries studied, 67.3 per cent is purchased from mills, 26.3 from wholesalers, and 6.4 from retailers.

Table 3 gives details of distribution for 15 Eastern and Central States.

According to questionnaires returned, wholesalers sell 19 per cent of their lumber to industries, including 29 per cent of their lengths under 8 feet, while retailers' sales to industries vary between extremes of 1 per cent in Arkansas and 37 per cent in Massachusetts, ranging from 3 to 11 per cent in other States. In no case do retailers' industrial sales exceed 15 per cent of their short lengths.

Among the principal industrial uses reported as being served directly by the wholesaler are: Crates and boxes; sash, doors, and millwork; patterns and flasks; construction, mines, and railways, agricultural implements, and automobiles.



TABLE 1.—Industrial uses for short lengths studied in greatest detail, including the principal outlets for worked items

Use	Proportion of estimated industry covered by survey	Estimated softwood consumption of industry	Lumber products purchased										Purchased in lengths under 8 feet					
			Boards, mostly 4/4						Ceiling and mostly partition	Flooring	Siding	D&M	Others	Cutting lengths under 8 feet	Random	Specified	Products	
			Dressed		Dimension and mostly 8/4													
			M ft. b. m.	M ft. b. m.		M ft. b. m.	M ft. b. m.	M ft. b. m.	M ft. b. m.	M ft. b. m.	M ft. b. m.	M ft. b. m.	M ft. b. m.	M ft. b. m.	M ft. b. m.	M ft. b. m.	M ft. b. m.	M ft. b. m.
Wood-fabricating industries: <sup>1</sup>	Per cent																	
Refrigerators.....	47	36,000	8,640	5,400	2,160	12,210	2,520		4,320									Old and Part., Sdg., Flg.
Ice-cream cabinets.....	42	11,500	3,450	2,415	920	4,140	460		115									Old and Part., Sdg., Flg.
Automobile export boxes.....	50	95,000			32,300				62,700									Old and Part.
Portable and ready-cut buildings.....	34	245,000	31,850	31,850	85,750	9,800	12,250	53,900	12,250									Sdg., Dim., D&M.
Caskets, coffins, and shipping boxes.....	36	102,000	79,560	8,100					11,220									Sdg., Dim., D&M.
Garage door panels.....	25	14,000	5,040	4,200		1,960												Old and Part.
Incubators and brooders.....	50	10,000	3,200	4,100		800	1,200											Sdg., Clg., Flg.
Commercial fixtures.....	28	23,000	5,750	15,870		690												Sdg., Clg., Flg.
Tanks and vats.....	20	59,000	49,560	9,440														Rough, S2S.
Automobile running and floor boards.....	29	30,000		30,000														Rough.
Screen doors.....	32	20,000	7,600	12,400														S2S.
Stairladders.....	40	13,000	3,120	8,190														S2S.
Sign panels.....	25	30,000	18,000	7,500														S2S.
Washing machines.....	22	14,000	12,600	700														S2S.
Beehives.....	60	10,000	1,200	8,500														S2S.
Agricultural implements.....	32	130,000	66,300	41,600														S2S.
Cable reels.....	50	13,100	2,882	1,965	4,323													S2S.
Toys.....	14	2,300	1,265	713														S2S.
Amounts.....		857,900	233,717	217,703	167,953	29,630	32,030	53,900	94,815	29,052	594,880	17,327	101,106					S2S.
Percentage of total.....		100.00	27.2	25.4	19.5	3.5	3.7	6.3	11.0	3.4	69.3	2.0	11.8					S2S.
3 nonwood industries: <sup>2</sup>																		S2S.
Amounts.....		210,000	70,350	110,250	21,000													S2S.
Percentage of total.....		100.00	33.5	52.5	10.0													S2S.
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<sup>1</sup> Sources of lumber consumed: Mill, 87.4 per cent; wholesaler, 11.4 per cent; retailer, 1.2 per cent.<sup>2</sup> Sources of lumber consumed: Mill, 67.3 per cent; wholesaler, 26.3 per cent; retailer, 6.4 per cent.



TABLE 2.—Industrial uses for short lengths for which only general data were obtained

Products	Softwood consumption	Principal species	General quality	Main items bought	Principal thicknesses	Principal cutting lengths	Purchase of shorts
Boxes and crates	<i>M ft. b. m.</i>	Softwoods and hardwoods	Box	Boards, plank	4/4, 6/4, 8/4	40 inches and under	Common.
Railway cars	2,700,000	Yellow pine, Douglas fir, oak	No. 1 Com. & Btr.	Worked, Dim.	4/4 and thicker	5 feet and over	Do.
Millwork	835,000	Pines, miscellaneous softwoods, hardwoods	Select and Shop	Boards, plank	4/4 to 8/4	7 feet and under	Do.
Woodenware	100,000	Soft pines, spruce hardwoods	Select	Bolts, staves, lumber	3/8 and thicker	30 inches and under	Occasional.
Automobile (domestic)	60,000	Yellow pine	Common	Dim., strips	8/4 and 4/4	7 feet and under	Do.
Shade and map rollers	62,500	Soft pines	Select	Rough lumber, squares	4/4 to 8/4	4 feet and under	Common.
Patterns and flasks	20,000	White pines	Select and Shop	Plank	6/4 and thicker	7 feet and under	Rare.
Grain doors		Softwoods and hardwoods	Low Common	Boards	4/4	7 feet	Common.
Fences		Softwoods	Common	Dressed boards	4/4	5 — 6 feet	Occasional.
Piano boxes	20,000	Spruce, soft pines, hardwoods	Common and Box	D&M. dressed boards	4/4 to 5/4	6 feet and under	Common.
Car racks		Softwoods and hardwoods	Common	Strips, Dim.	4/4 and 8/4	8 and 2 feet	Occasional.
Scale beam boxes		Pines, Douglas fir	High Com. and Select	Part., dressed boards	5/8, 4/4, 8/4	6 feet and under	Do.
Factory trucks		Yellow pine	High Common	Boards	4/4	do	Do.

TABLE 3.—*Retail and wholesale distribution of softwood yard lumber, including short lengths*

State	Number of yards reporting	Proportion of industrial sales to total sales	Proportion of lengths under 8 feet to all lengths	Relative amount of lengths under 8 feet				Number of yards making wooden products	Proportion of lengths under 10 feet to all lengths
				Purchased as—		Sold to—			
				Dressed	Worked	Building trades	Industries		
Retail yards:	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>		<i>Per cent</i>
Massachusetts.....	7	37	4	73	22	60	10	1	8
New York.....	18	11	4	50	36	97	2	7	10
New Jersey.....	4	6	2	46	47	75	15	2	4
Pennsylvania.....	44	10	2	36	56	85	3	8	5
Ohio.....	89	9	3	40	55	92	4	23	9
Kentucky.....	20	10	5	55	42	88	6	4	8
Indiana.....	13	5	5	42	54	86	12	5	10
Michigan.....	16	7	5	57	43	86	12	4	12
Wisconsin.....	105	7	5	46	46	85	7	16	11
Illinois.....	45	3	3	53	46	93	-----	5	8
Minnesota.....	32	10	6	42	50	90	8	8	11
Iowa.....	25	10	6	48	48	92	4	7	10
Missouri.....	50	10	3	51	46	90	6	9	8
Arkansas.....	9	1	4	46	54	96	1	-----	7
Kansas.....	16	10	4	54	46	89	-----	1	4
Wholesale yards in 24 States	76	19	6	27	48	1 64	29	-----	13

<sup>1</sup> Sold to retailers.

Industrial customers of retail yards were reported to be engaged in the manufacture of the following products, among others, the items being listed in descending order of frequency of mention: Machinery, automobiles, stoves and furnaces, sheet-metal products, hardware, agricultural implements, structural steel, paper, furniture, tile and pottery, roofing, and textiles.

Retailers in different States receive from 2 to 6 per cent of all their lumber in lengths under 8 feet and wholesalers 6 per cent. This material may be classified as follows:

Form of lumber	Whole-sale trade	Retail trade
	<i>Per cent</i>	<i>Per cent</i>
Worked.....	48	22 to 56
Dressed square-edged.....	27	36 to 73
Rough.....	25	0 to 11

The findings indicate that 64 per cent of the retail dealers buy not more than 5 per cent of their lumber in short lengths; 86 per cent buy not more than 10 per cent in short lengths; 95 per cent buy not more than 15 per cent in short lengths; 99 per cent buy not more than 20 per cent in short lengths.

The following summary indicates the variation in retail-yard sales of nonbuilding items as between places of large and of small population:

Retail-yard sales of nonbuilding items	Yards in towns of less than 5,000	Yards in cities of over 100,000
Percentage of all lumber sold for uses other than the building trade.....	5.8	15.0
Percentage of total production of short-length lumber sold to industrial trade.....	2.3	11.2
Percentage of all lumber used in making wooden products in connection with yard operation.....	2.5	7.6

Dealers in the cities have the better opportunity to supply the industrial trade, which buys a larger part of its lumber in short lengths than does the building trade. The total lumber consumption of the building trade, however, is so much greater than that of the industries that the former will no doubt continue to offer the largest single outlet for shorts regardless of locality.

### INCREASING THE INDUSTRIAL USE OF SHORT LENGTHS

The short-length problem, in so far as industrial markets are concerned, has no simple or easy solution; otherwise it would have been solved long ago. Nevertheless the manufacturing and marketing difficulties are being overcome in a great number of cases, and examples of such progress among both manufacturers and consumers offer the most convincing evidence of what may be done. Cutting to size at the mill is being practiced with increasing frequency as the requirements for products such as stepladders, incubators, refrigerators, and sectional houses make themselves felt. Public agencies can accelerate the tendency somewhat by collecting and distributing helpful information, but the success of the movement in general depends upon the initiative of the lumber trade itself.

If serious efforts are to be made to get short lengths into the industrial market, as large a proportion of the shorts as possible should occur in items that are most easily utilized in manufacture—that is to say, in square-edged pieces rather than in lumber worked to pattern. A practice followed by a few mills consists in surfacing the piece and trimming out serious defects before machining to pattern. This results in square-edged shorts which may be sold in that form or machined as desired.

In plants where short lengths are used with the greatest satisfaction the following conditions usually prevail:

1. A large proportion of the lumber used is consumed in a limited number of cutting lengths.
2. Shorts are purchased in carload lots from reputable sources.
3. Shorts are purchased in bundles of specified lengths.

The lumber producer wishing to take advantage of such conditions, where they exist, will in many cases find it necessary not only to pay greater attention to merchandising but also to provide for more extensive remanufacturing at the sawmill. A shipment of random-length shorts may prove more burdensome than helpful to the user. One of the common objections offered by the industrial consumer to the use of short lengths is the increased waste involved. It can readily be seen that if a manufacturer has use for material in lengths of  $3\frac{1}{2}$  feet and is required to buy mixed 4 and 6 foot lengths and cut them back, his waste is excessive.



The actual waste, freight on the waste, and cost of cutting combine to make such shorts dear at any reasonable figure. It is equally obvious, however, that this objection can be met by furnishing material cut to the required length or multiple thereof.

Another frequent objection is that of increased handling costs. In many cases it can be removed by bundling the stock.

From the distributors' standpoint, in particular, the additional space required for a greater variety of lengths presents a considerable difficulty, which must be surmounted by the best means available in the individual case.

The distributor sometimes takes an indifferent attitude toward the short-length requirements of the industrial trade in general as a result of losing to the mill all industrial customers except buyers of less than carload lots. Many occasional consumers of short lengths complain of the difficulty of finding a reliable source of supply, and the producer likewise complains of the lack of a reliable market. The dissemination of information on the production and the actual and potential consumption of short lengths would tend to stabilize conditions and to bring about more satisfactory relations among the parties at interest.

In some cases short lengths have been offered at attractive introductory prices and later, after the trade has become more or less accustomed to them, the price has been raised to a point considered by the purchaser unreasonable. Cost studies would be helpful in such cases.

It is undoubtedly true that there are distinct limits within which the use of short lengths is practicable. The size of cuttings demanded in certain wood-using manufactures may be so varied and so subject to change from time to time that they can not be foreseen with any degree of accuracy. It would appear advisable for such industries to purchase much of their lumber in sizes that will produce the largest cuttings for which there is any demand. Long lengths are readily convertible into any size desired, whereas short lengths in obsolete sizes have very little value. It is claimed that the saving effected by reducing the quantity of stock on hand through the use of long lengths sometimes more than offsets any possible direct financial advantage from the purchase of short lengths. The particular answer to such questions can be found only through cost-finding studies to determine the relative value of short and long lengths. Values will of course vary with different industries and between different plants in the same industry. Although the price, which is often the determining factor, resolves itself into a matter of supply and demand, there is need for basic cost analyses which will emphasize value rather than price. Special efforts on the part of lumber producers toward educating the trade in the possibilities of short-length utilization would be well worth while. An example of the obstacles to be removed is the common and insistent preference of customers for 16-foot lengths, almost without regard to the purpose for which they are intended. With large industrial concerns lumber is often one of the less important purchases and one with which the purchasing agent is not thoroughly familiar. He frequently fails to specify his requirements to the best advantage, and he may or may not be receptive to inquiries and suggestions. There are always those



who will gladly fill his orders without question, and the dealer who must compete will often withhold valuable suggestions rather than risk a sale.

#### USES FOR SHORT LENGTHS STUDIED IN GREATEST DETAIL

The products for which short lengths are known to be used in considerable quantities at present and for which the possible increase in consumption can be estimated, particularly in lumber worked to standard patterns, are described in the pages immediately following. The fact that the manufacturers of these products are organized into trade groups or that the product is made by a relatively few, or specialty, companies has made it possible to come to reasonably definite conclusions as to their present and potential requirements for shorts. Such information as is thought to be characteristic of the industry as a whole, or of a large part of it, is given, therefore, for its value in arriving at an understanding of consumption requirements.

#### REFRIGERATORS

Refrigerators may be classified as household refrigerators and commercial refrigerators or coolers, such as are commonly found in stores, restaurants, and hotels. The former are usually manufactured on a quantity production basis, since a large part of the demand is for a few sizes. Many of the latter, however, are made to order, and even the sizes in best demand and manufactured at the largest plants are seldom made in runs of more than 40 at a time. Because the manufacturer of commercial refrigerators can not foresee the sizes and styles which will be required, he must buy his lumber in such form that it can be used for anything the trade may demand.

#### GENERAL SCHEME OF CONSTRUCTION

Although there are all-metal refrigerators on the market, lumber is by far the most used raw material. Lumber used in refrigerator manufacture may be divided into four main classes—finish, backing and bottoms, lining, and framing.

*Finish.*—In domestic refrigerators finish is nearly always of hardwood except where displaced by porcelain or enamel. The cheaper "ice boxes" (opening at the top) are often made entirely of softwoods. In commercial refrigerators the finish is usually of hardwood when appearance is a consideration, otherwise they may be built entirely of softwood. In either case the lumber used is of high quality.

*Backing and bottoms.*—Both hardwoods and softwoods are used for backing and bottoms. The choice is usually governed by price and availability. It appears, however, that the use of softwoods is the more common. The grade of the lumber varies according to the quality of the product made.

*Lining.*—Softwoods are used to much greater extent than hardwoods for refrigerator linings. There is considerable variation in the size and quality of material used, according to the method of construction and the quality of the finished article. Metal or porcelain are generally used to make a tight compartment between the wood and the interior, in which case lumber of high quality is not

required. Where the wooden lining is not so separated from the refrigerator contents, high-grade lumber and machine work are generally required. The lining in the latter case is heavily enameled after assembling.

*Framing.*—The material used for framing varies from 5/4 to 8/4 inches in thickness according to the size of the refrigerator. In some of the larger commercial refrigerators the walls are constructed much like the walls of a house, with regular 2 by 4 dimension for framing, whereas in the ordinary domestic refrigerator much lighter material answers the purpose. The quality of the framing varies from a clear grade to No. 2 Dimension.

#### LUMBER CONSUMPTION

From data obtained in the course of these studies it is estimated that the manufacture of refrigerators consumes annually 112,000,000 board feet of lumber. Of this total, hardwoods comprise 68 per cent, or 76,000,000 board feet, and softwoods 32 per cent, or 36,000,000 board feet.

#### PROPERTIES REQUIRED IN THE LUMBER

For the inner lining of refrigerators it is important that the wood shall be tasteless and odorless, particularly where not protected by metal or porcelain. Moreover, the wood thus exposed is subjected to conditions conducive to decay, and durability (resistance to decay) therefore becomes a factor of importance. The worth of the refrigerator depends on its insulating properties, which in turn depend on the tightness of its construction. For these reasons ability to machine well and to stay in place is of prime importance. Moderate strength and moderate nail-holding ability are required. Knots, if any, should be tight, machine work good, and moisture content low enough to prevent subsequent shrinkage.

#### CONSUMPTION OF SOFTWOODS BY SPECIES AND ITEMS

The species and approximate relative quantities of softwoods used in refrigerator manufacture are:

	Per cent
Soft pine .....	25
Hard pine .....	23
Spruce .....	21
Hemlock .....	18
Fir .....	12
Cypress .....	1

The various items of lumber are purchased in the following proportion:

	Per cent
Ceiling and partition .....	34
Rough .....	24
Dressed, square-edged .....	15
Dressed and matched .....	12
Flooring .....	7
Dimension .....	6
Shop .....	2

The following list indicates the sizes, grades, items, and uses of the softwoods in refrigerator manufacture:

Soft pine:

- 4/4" x 4"; No. 3 Common; special pattern, to be resawed into 3/8-inch shiplap for lining.
- 4/4" x 4"; No. 3 Common; dressed and matched for backs and bottoms.
- 6/4" x 6" and wider; No. 3 Common; for framing.

NOTE.—For the purpose of this report northern white pine, western white pine, and western yellow pine are considered together as soft pine.

Hard pine:

- 4/4" x 4"-6"; car siding; for backing.
- 4/4" x 4"; C and Better; ceiling and partition; for lining and backing.
- 1/2" x 4"; C and Better; ceiling; for lining.
- 4/4" x 3"-4"; No. 1 Common and Better; flooring; for bottoms.
- 8/4" x 4" and wider; No. 2 Common; dimension; for framing.

NOTE.—The several commercial species of southern yellow pine are here considered as hard pine.

Spruce:

- 4/4" x 3" and wider; No. 1 and 2 Common; dressed and matched; for lining.
- 6/4"-8/4" x random widths; No. 1 Shop; for framing.
- 4/4" x random widths; No. 1 Shop; rough; for lining.
- 4/4" x 4"; No. 2 Clear and Better; for lining.

NOTE.—Both eastern and western spruce are used interchangeably owing to general similarity in their qualities.

Hemlock:

- 5/8" x 4"; No. 3 Clear and Better; ceiling; for lining.
- 4/4 x 4"; No. 3 Clear and Better; flooring; for backing and bottoms.
- 4/4" x 6"; merchantable; special pattern to be resawed into 3/8-inch shiplap for lining.

NOTE.—Both eastern and western hemlock are included under this head since they are used for similar purposes.

Douglas fir:

- 5/8" x 4"; No. 3 Clear and Better; ceiling; for backing.
- 4/4" x 4"; No. 3 Clear; flooring; for bottoms.
- 8/4"; No. 1 and 2 Common; dimension; for framing.
- 4/4" x 6"; No. 1 and 2 Common; special, to be resawed into 3/8-inch shiplap; for lining.

Cypress:

- 4/4" x random widths; No. 2 Common; rough; for lining.
- 4/4" x random widths; Selects; rough; for trim.

LENGTHS PURCHASED

Of the softwood lumber used in the manufacture of refrigerators 85 per cent is purchased in lengths of 8 feet and over, 10 per cent in specified lengths under 8 feet, and 5 per cent in random lengths under 8 feet. In round figures, therefore, 15 per cent of the total is bought in short lengths.

ITEMS BOUGHT IN SHORT LENGTHS

The following are the principal items of short lengths, in the order of their importance:

- 5/8" x 4"; Selects; ceiling and partition; in fir and hard pine.
- 4/4" x 4"; Selects; flooring; in fir, West Coast hemlock, spruce, and hard pine.
- 4/4" x 4"; Car siding; in hard pine.
- 4/4" x 4"-6"; B & Better; ceiling; in hard pine.



## CUTTING LENGTHS

*Household refrigerators.*—Practically all cuttings used in household refrigerators come within the range of 12 to 50 inches in length, and the quantity of cuttings 8 feet or over is negligible.

*Commercial refrigerators.*—The products in best demand for commercial purposes are the relatively small general-purpose refrigerators such as are used in chain groceries. The preferred sizes are from 30 to 40 inches wide, 4½ to 7 feet long, and 6 to 7 feet high. Even the maximum length used in these sizes is under 8 feet. Much lumber is used for refrigerators of much greater size, but even in such cases most of the cuttings are well under 8 feet in length.

## POSSIBLE EXTENSION OF USE OF SHORT LENGTHS

The manufacture of household refrigerators offers one of the most promising outlets for shorts. The product is fairly well standardized and the needs can be foreseen rather accurately. Practically all cuttings are short and within a relatively narrow range in size.

That the increased use of shorts depends largely on merchandizing and salesmanship is indicated by the fact that several factories buy 75 per cent of their softwoods in specified short lengths, with pleasing results, while others, under quite similar conditions, buy none and have never seriously considered using them.

Nearly half the companies canvassed expressed themselves as favoring the use of short lengths, though with certain qualifications as to the quantities which could be used and as to the purchase price.

## SOURCES OF LUMBER

The lumber consumed was purchased from the sources and in the proportions shown below:

	Per cent
Mills.....	65
Wholesalers, jobbers, and commission men.....	33
Local retailers.....	2

## ICE-CREAM CABINETS

Ice-cream cabinets and coolers for bottled beverages are considered together. The manufacture of these products bears a rather close similarity to the refrigerator industry as regards the kinds and qualities of wood used and the methods of construction, but the products are seldom made in connection with refrigerators.

## GENERAL SCHEME OF CONSTRUCTION

Three classes of material are used—lining, outer case, and framing. In some instances the cabinets are of all-wood construction, while in others considerable amounts of metal and porcelain are used.

## LUMBER CONSUMPTION

From data obtained in the course of these studies it is estimated that the manufacture of ice-cream cabinets consumes yearly 11,500,000 board feet of softwoods, and a small quantity of hardwood lum-



ber in approximately the same species and grades as are used for refrigerators.

#### PROPERTIES REQUIRED IN THE LUMBER

The principal properties required of softwoods for this use are stability ("ability to stay in place"), good working qualities, and, in a special degree, durability (resistance to decay). For outer cases, appearance is of importance, as well as ability to take finish. For the entire product insulating qualities are obviously a prime requisite.

#### CONSUMPTION OF SOFTWOODS BY SPECIES AND ITEMS

The principal softwood species used are redwood, southern yellow pine, and white pine, in about equal quantities, with somewhat smaller amounts of cedar, cypress, fir, and spruce. These woods are purchased in the following forms and proportions:

	Per cent
Ceiling and partition-----	36
Rough-----	30
Dressed, square-edged-----	21
Dimension-----	8
Flooring-----	4
Dressed and matched-----	1

#### LENGTHS PURCHASED

Lengths of 8 feet and over comprise 64 per cent of the total amount consumed, specified short lengths 35 per cent, and random short lengths 1 per cent.

#### ITEMS BOUGHT IN SHORT LENGTHS

The principal sawmill products bought in lengths less than 8 feet are fir partition 5/8" x 4" and 4/4" clear redwood S2S.

#### CUTTING LENGTHS

Ice-cream cabinets are, as a rule, about 30 inches high. Since the lengths used in the outer case extend vertically, height is the most important dimension.

#### SOURCES OF LUMBER

The lumber consumed was purchased from sources and in proportions as follows:

	Per cent
Mills-----	78
Wholesalers-----	15
Retailers-----	7

#### POSSIBLE EXTENSION OF USE OF SHORT LENGTHS

The wide discrepancy between the quantity of lumber bought in short lengths (36 per cent) and the quantity so used (all) indicates the possibility of enlarging this market for shorts. Already several companies report buying half or more of their lumber in specified short lengths.

## AUTOMOBILE EXPORT BOXES

Owing to the danger of damage in transit, it is essential that automobiles and trucks for export be carefully boxed. The export boxes are sometimes made by the automobile manufacturers themselves and sometimes by independent concerns.

## GENERAL SCHEME OF CONSTRUCTION

Although methods of construction necessarily vary with the specifications of the shipper, and to some extent with the manufacturing practices of the box maker, there are certain points of fairly general application. To insure accuracy and speed of production the use of assembly jigs is common. To facilitate handling and save space in transit it is customary to make the boxes in units, that is, to construct the sides, tops, and ends separately, and then to transport

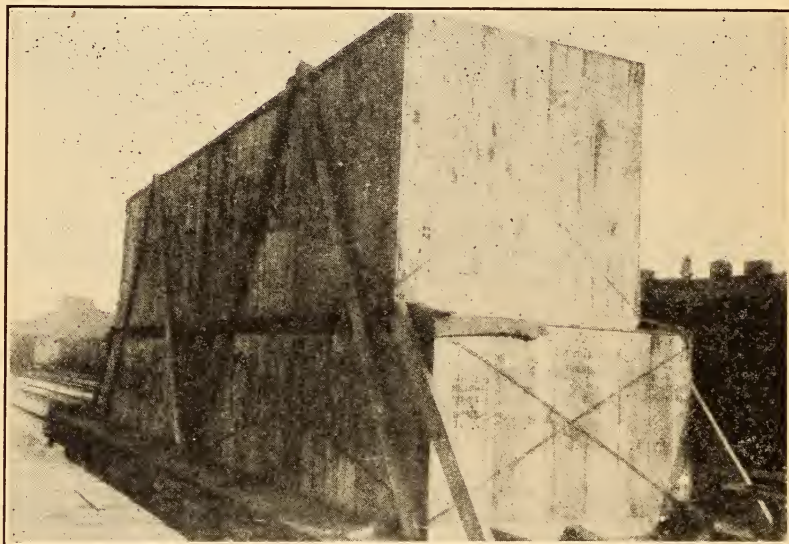


FIG. 1.—Automobiles boxed for export. Some 95,000,000 feet of softwoods is used yearly for such boxing, largely  $\frac{3}{4}$  boards in lengths of approximately 4 and 6 feet

them in that form for assembly at the point of use. As a general rule boxes are lined with tar paper, artificial building boards, or other protective material, according to the purchasers' specifications. Figure 1 shows the types of boxes discussed.

## LUMBER CONSUMPTION

In 1923, 127,237 automobiles and 24,859 auto trucks were exported. On this basis it is conservatively estimated that more than 100,000,000 board feet of lumber is required annually, of which probably not more than 5,000,000 feet is hardwoods.

## CONSUMPTION OF SOFTWOODS BY SPECIES AND ITEMS

A large proportion of automobiles are manufactured in regions within the shipping radius of the southern yellow pine region. This

is one of the reasons why southern yellow pine is the chief wood used for auto export boxes. In the plants visited, all the 2-inch framing material, constituting approximately one-third of the lumber used, was of this wood. It was purchased in widths of 4 to 8 inches and in the grade of No. 2 Dimension. The choice of species for 1-inch sheathing depends upon the purchaser. Often No. 2 Common southern yellow pine, 1 by 6 inches, dressed and matched, is selected. Certain manufacturers, however, specify western yellow pine in the same grades and size, or No. 1 Common hemlock. As has been previously remarked, the market is almost entirely confined to softwoods.

#### LENGTHS PURCHASED

Sizes in which the lumber is purchased vary with the plant. In all the plants that were visited the framing was purchased in lengths of 10 feet and up, but in some cases the 1-inch material was purchased cut to the desired lengths.

#### CUTTING LENGTHS

Aside from framing members which extend the full length of the case, nearly all the lumber in the commonest size of box is used in lengths of approximately 4 and 6 feet. This rule applies to much of the 2-inch framing as well as to the 1-inch sheathing. The exact cutting lengths necessarily vary according to whether the box is intended for one chassis, for two chassis, for an assembled car, or for a truck.

#### POSSIBLE EXTENSION OF USE OF SHORT LENGTHS

The manufacture of automobile export boxes appears to constitute a use to which short lengths are well adapted. Here, however, "short lengths" refers to material furnished cut to the exact lengths desired and not to random lengths. It is difficult to see how random shorts could be used without increasing freight, labor, and overhead costs, percentage of waste, and storage space requirements, besides lowering rates of production. In other words, shorts would have to be cut to size at the mill.

#### SOURCES OF LUMBER

All the lumber used in the plants visited was purchased directly from mills.

#### SECTIONAL AND READY-CUT BUILDINGS

Although there are a few large companies manufacturing for distribution over a large territory, in most cities of any considerable size there will be found one or more concerns making portable or ready-cut buildings largely for local use. Such manufacture is often combined with a retail or wholesale lumber business, or with the operation of planing mills and woodworking factories.



## METHODS OF MANUFACTURE

*Ready-cut buildings.*—The preparation of material for ready-cut buildings consists in cutting the lumber to the exact sizes required in the finished building. The objects are to save labor at the point of erection and to use the lumber to best advantage.

*Portable or sectional buildings.*—Probably the most common types of portable or sectional buildings are garages and summer cottages. Such buildings, however, are not necessarily small. Gymnasiums, temporary schools, and even two-story buildings are sometimes made in sections. Walls, roofs, and floors are made in sections which vary from 2 to 4 feet in width. The sections consist of sheathing, siding, or flooring nailed to studs or joists. Figure 2 shows some typical sections produced at a large Illinois factory. The finished sections are transported to their destination and there bolted together in final assembly.

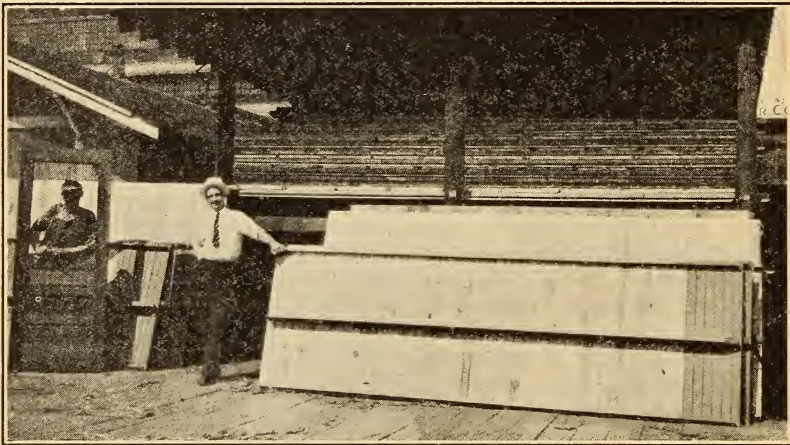


FIG. 2.—Finished 4-foot roof sections. Sectional and ready-cut buildings require about 250,000,000 feet yearly, of which slightly more than half is used in short lengths and only about one-sixth is bought in that form

## LUMBER CONSUMPTION

From data obtained in the course of these studies it is estimated that the construction of portable and ready-cut buildings requires, annually, 250,000,000 board feet of lumber, including 5,000,000 feet of hardwoods.

## CONSUMPTION OF SOFTWOODS BY SPECIES AND ITEMS

The species most commonly used is southern yellow pine, followed in order of importance by Douglas fir, cedar, hemlock, redwood, and spruce. The following list presents details as to the sizes, grades, and items used in the various woods:

## Southern yellow pine:

- 8/4" x 4" and wider; No. 1 and 2 Dimension; framing.
- 4/4" x 4" and wider; No. 2 Common; sheathing.
- 4/4" x 4" and wider; B and Better; trim.
- 4/4" x 4"; No. 1 Common and Better; drop siding.
- 4/4" x 4"-6"; C and Better; ceiling and partition.
- 4/4" x 6" and wider; No. 1 Common; dressed and matched.



Douglas fir:

4/4" x 4"-8"; No. 3 Clear and Better; drop siding.

4/4" x 3"; No. 3 Clear and Better; flooring.

5/8" x 4" and 4/4" x 4"; No. 3 Clear; ceiling.

4/4" x 6" and wider; No. 1 Common; sheathing.

Cedar:

4"; C and Better; bevel siding.

Hemlock (eastern):

8/4"; Merchantable; dimension.

4/4" x 6" and wider; Nos. 1 and 2 Common; sheathing.

Redwood:

6"; Clear; bevel siding.

Spruce (eastern):

8/4"; Merchantable; dimension.

The proportions of the different items in the total are shown in the list which follows:

	Per cent
Dimension -----	35
Boards -----	26
Siding -----	22
Dressed and matched -----	5
Flooring -----	5
Ceiling -----	4
Shiplap -----	3

#### LENGTHS PURCHASED

Of the lumber used in the manufacture of portable and ready-cut buildings 82 per cent is bought in lengths of 8 feet and over, and 18 per cent in lengths under 8 feet. The lengths less than 8 feet are practically all specified.

#### ITEMS BOUGHT IN SHORT LENGTHS

Different forms of lumber are reported as being bought in short lengths in the following order of frequency:

4/4" x 4"-8"; drop siding.

8/4" x 4" and wider; dimension.

4/4" x 4" and wider; common boards.

5/8" x 4"; 4/4" x 4" and 6"; ceiling.

4/4" x 3"; flooring.

4", 6". widths; bevel siding.

4/4" x 4" and 6"; trim.

#### CUTTING LENGTHS

*Ready-cut buildings.*—Cutting lengths used in ready-cut buildings do not differ materially from those in ordinary building construction. According to Forest Service data, 36 per cent of the lumber in small dwelling houses is used in lengths under 8 feet.

*Portable or sectional buildings.*—Practically the only parts of portable or sectional buildings that are used in lengths greater than 8 feet are sills, plates, studs, and rafters. The sections are usually made in widths from 2 to 4 feet, and the lengths of siding, flooring, and sheathing must be equal to these section widths. The framing material comprises slightly more than one-third of the lumber used, and some of this is necessarily short (fig. 3). A very conservative estimate, therefore, would be that two-thirds of the lumber used is in lengths of 2, 3, and 4 feet.

## POSSIBLE EXTENSION OF USE OF SHORT LENGTHS

In cases where short lengths are being used to the best advantage it is found that waste is minimized by buying specified rather than random lengths. Excessive handling costs are eliminated through the purchase of material bundled according to length. Cutting to length and bundling of course increase slightly the price paid for the lumber.

The possible increase in the use of shorts is indicated by the fact that more than half of the material consumed is used in short lengths whereas only 18 per cent is purchased in that form. This percentage is, of course, an average; already there are individual companies that buy over 50 per cent of their lumber in short lengths.

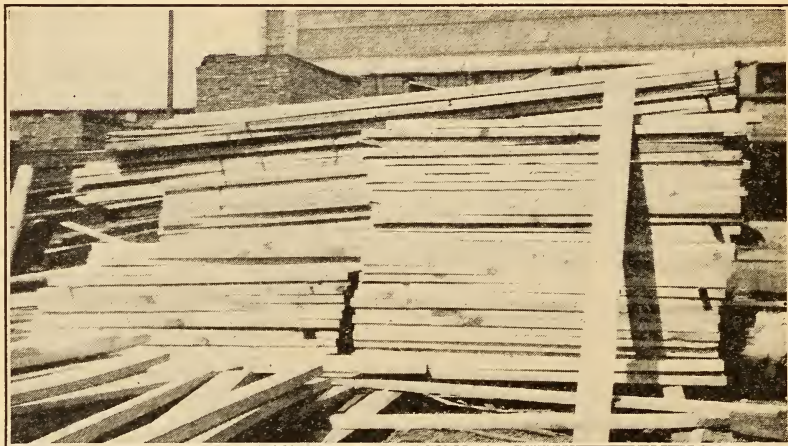


FIG. 3.—A pile of 6-foot 2 by 6 inch material to be worked up into sectional houses. In all buildings there are places requiring comparatively short lengths, and manufacturers of sectional and ready-cut buildings often find it practicable to use short dimensions in carload lots

## SOURCES OF LUMBER

The lumber consumed in the manufacture of sectional and ready-cut buildings other than those made incidentally in connection with lumber-yard businesses, is purchased from the following sources:

	Per cent
Mills.....	91.5
Wholesalers.....	8.5

## COFFINS, CASKETS, AND OUTSIDE BOXES

Although there are certain well-marked differences between requirements for caskets and coffins and those for outside boxes, all are customarily made in the same factories.

Although metal has been increasingly used in the manufacture of coffins and caskets, it appears doubtful if, with the heavier demands due to a larger population, the volume of wood used has decreased.

Wood caskets and coffins are manufactured both cloth-covered and in natural finish. The cloth-covered type takes practically all the softwood lumber used. A sound, knotted quality is satisfactory.

Nearly all the natural-finish coffins and caskets are of hardwood, though small quantities of cypress and southern red cedar are used. For the manufacture of natural-finish coffins and caskets lumber of high quality is required.

By far the commonest type of shipping box is of sound, tight-knotted dressed and matched softwood, such as that illustrated in Figure 4. Another type is of high-quality lumber, either hardwood or softwood, and is given a first-class finish. In some factories shipping boxes are the only use for which softwoods are purchased.

#### GENERAL SCHEME OF CONSTRUCTION

*Coffins and caskets.*—Commonly caskets are rectangular or elliptical; coffins have the traditional hexagon shape. The basis of the casket or coffin is a wooden box or shell to which moldings of different sizes and shapes are added at top and bottom to give the final form. In constructing the covers molding are also largely used.

*Outside boxes.*—The outside box is usually very simple in its construction, the pieces running lengthwise on the side and crosswise on the top and bottom.

For coffins, caskets, and boxes some material is now purchased in the form of shoeks. Moldings often come already machined to the desired patterns. The practice of buying material in these forms rather than as lumber appears to be increasing.

#### LUMBER CONSUMPTION

The industry uses approximately 185,000,000 board feet of lumber yearly, of which approximately 102,000,000 board feet are softwoods and 83,000,000 hardwoods. Seventy-four million of the total are used for shipping boxes, which are almost entirely of softwoods. Slightly more than 28,000,000 board feet, therefore, consists of softwoods used in coffins and caskets.

#### PROPERTIES REQUIRED IN THE LUMBER

The properties required, particularly for the natural-finish coffins and caskets, are similar to those for high-grade cabinet material, viz, ease of working, ability to take a good finish, resistance to warping and shrinking, and durability. The same properties, except ability to take a good finish, are essential for cloth-covered caskets. Outside boxes require materials of moderate strength and nail-holding ability.

#### CONSUMPTION OF SOFTWOODS BY SPECIES, ITEMS, AND GRADES

The species of softwood used in the construction of caskets, coffins, and shipping boxes, in the order of their importance, are as follows:

	Per cent
White pine -----	33
Cypress -----	24
Western yellow pine -----	22
Southern yellow pine -----	10
Western red cedar -----	6
Redwood -----	5



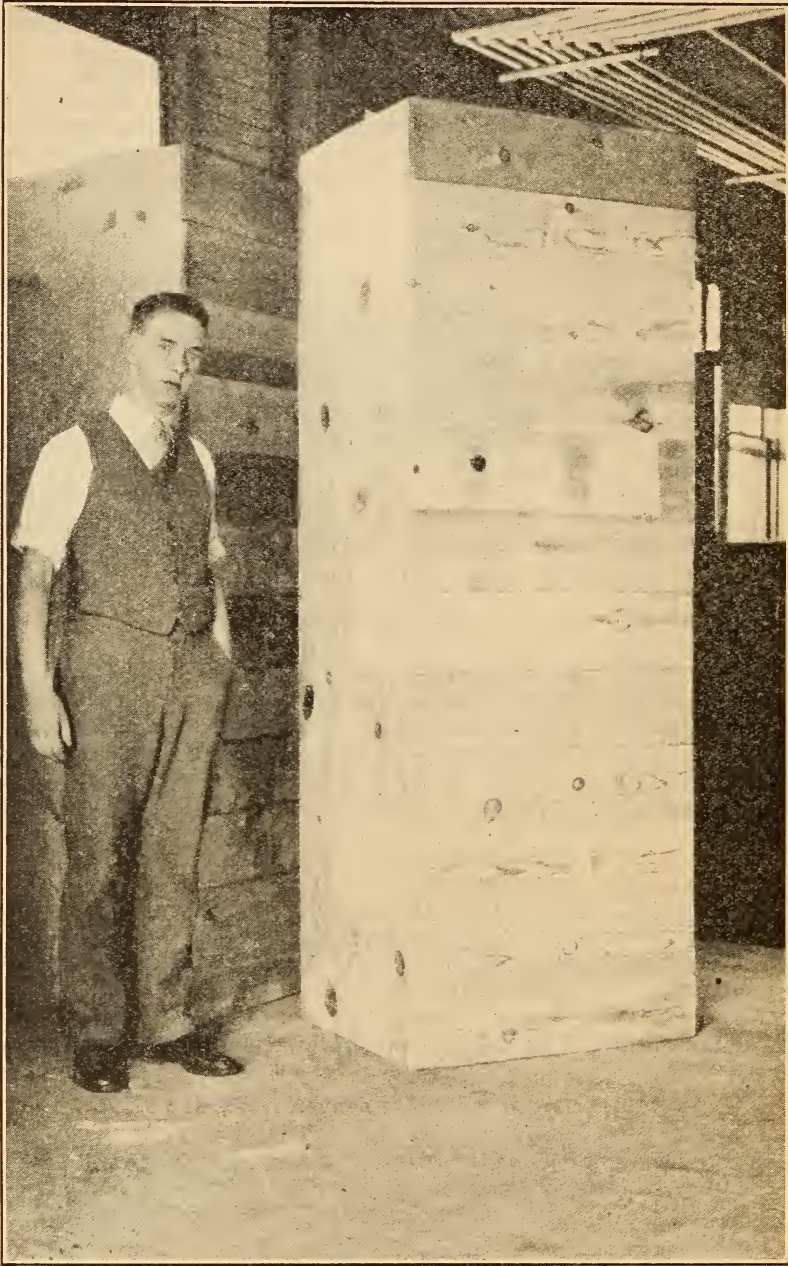


FIG. 4.—Shipping boxes for burial caskets. This use requires about 70,000,000 feet yearly, chiefly of No. 2 common quality, usually D&M. The usual method of construction, as illustrated, allows over half the lumber in the commonest sizes to be less than 30 inches long. The lumber bought in shook form is only a small percentage of the total consumption



The softwood lumber is purchased in the following items:

	Per cent
Rough.....	78
Dressed and matched.....	11
Dressed, square-edged.....	8
Miscellaneous.....	3

The true white pines and western yellow pine are used in this industry for the same purposes and in equivalent grades; consequently they are considered under the same heading. The items purchased are:

Soft pine:

4/4" and 6/4" x 6" to 12" x 10'-16'; No. 2 and No. 3 Common; for cloth-covered caskets and for outside boxes.

Cypress:

4/4" x 6" and wider x 8' and longer; FAS and No. 1 Common; for natural-finish coffins and caskets.

4/4"-6/4" x 6" and wider x 8' and longer; No. 1, No. 2, and No. 3 Common; for cloth-covered caskets.

4/4" x 6" and wider x 8' and longer; No. 1 and No. 2 Common; for outside boxes.

Southern yellow pine:

4/4" x 10" and 12" x 10' and longer; No. 2 Common; for outside boxes.

4/4" x 10" and 12" x 10' and longer; No. 2 Common; for cloth-covered caskets.

Western red cedar:

4/4" x 6"-12" x 14' and 16'; No. 1, No. 2, and No. 3 Common; for cloth-covered caskets.

4/4" x 6"-12" x 14' and 16'; No. 1 and No. 2 Common; for outside boxes.

Redwood:

4/4"-6/4" x 8" and wider x 12' and longer; Select and Extra Merchantable for cloth-covered caskets.

Small quantities of spruce and Douglas fir are reported as used in cloth-covered caskets and outside boxes, and small quantities of southern red cedar in natural-finish caskets and shipping boxes.

#### SIZES PURCHASED

Of all the softwoods consumed in this industry 93 per cent are purchased in lengths of 8 feet and over, 5 per cent in specified lengths less than 8 feet, and 2 per cent in random short lengths.

With the exception of cypress and southern red cedar, all softwoods are purchased in specified widths of 10, 12, 8, 6, and 4 inches, in order of importance. It is the general opinion that lengths of 14 and 16 feet cut to the greatest advantage. Next in order of preference are lengths of 12 and 10 feet. The quantity of 8-foot material bought is practically negligible. The lengths as stated refer to lumber and not to shooks or other material cut to size.

Most of the lumber used in coffins and caskets and practically all lumber used in shipping boxes is 4/4 inch thick, individual manufacturers reporting that as much as 80 or 90 per cent of all the lumber they use is of that thickness. Thicker material is required for some of the largest sizes and for certain moldings, and some 5/4, 6/4, and 8/4-inch lumber is bought.

## ITEMS BOUGHT IN SHORT LENGTHS

The following items are the principal ones purchased in lengths under 8 feet:

4/4" x 6" and wider; No. 3 Common; white pine.  
 4/4" x 10" and 12"; No. 2 Common; yellow pine; box shooks.  
 4/4" x 4"; white pine; rough molding strips.  
 4/4", random widths, 6' lengths; No. 1 Common; cypress; rough.  
 Casket shooks in western hemlock, western yellow pine, and spruce.  
 Moldings and molded sides in redwood.

## CUTTING LENGTHS

*Coffins and caskets.*—The lengths of cuttings used in coffins and caskets vary widely, as may be seen from the following statement of sizes used by a typical manufacturer:

Lengths, 23 to 88 inches.  
 Widths, 12½ to 28½ inches.  
 Depths, 9½ to 21 inches.

Despite the wide range in sizes, however, a large part of the lumber is consumed in the construction of a very few sizes. Probably the most important size is 75½ inches in length, 22½ inches in width, and 14 inches in depth.

*Outside boxes.*—A range similar to the foregoing is found in the sizes of outside boxes. The sides and ends are usually made of two pieces running lengthwise and the tops and bottoms of pieces running crosswise. The significant result of the method of construction is that more than half the lumber used in the box is less than 30 inches in length. The shipping box in greatest demand has the following inside dimensions: 84 inches long by 27 inches wide by 22 inches deep.

## POSSIBLE EXTENSION OF USE OF SHORT LENGTHS

That the coffin and casket industry offers a large outlet for short lengths is indicated by the contemporary increase in the quantity of material bought in the form of shooks, either for caskets or for shipping boxes. This outlet should be developed, as the quality of material used in cloth-covered caskets and shipping boxes is seldom above No. 1 Common. A large part of the material, as used, is less than 30 inches long; hence short lengths furnished in multiples of 30 inches will be increasingly acceptable and will tend to eliminate objections arising from the high handling costs of exceptionally short material. One-third of the concerns which have had experience with short lengths report favorably as to the possibilities of developing their use. It may be that the remaining two-thirds have been using random-length shorts rather than cut-to-size material—the usual objection that there is too much waste would seem to indicate that such was the case.

## SOURCES OF LUMBER

Eighty-two per cent of the softwoods here considered was purchased from mills and 18 per cent from wholesalers.

#### GARAGE DOOR PANELS

Garage doors are one of many products consuming a certain quantity of short-length lumber along with standard lengths. Some few factories are devoted entirely to the manufacture of garage doors, and most door manufacturers make a few garage doors as part of their general line. In general the quality of material used is not high as compared with that used for doors of other types, and sound, knotted stock is customarily acceptable. Occasionally garage doors are made on the site by building contractors, but by far the greater number are factory products.

#### GENERAL SCHEME OF CONSTRUCTION

Garage doors are composed of a heavy framing, usually of 2-inch material, and lighter center panels.

The panels are of three different types: Plywood, solid one piece, and partition.

#### LUMBER CONSUMPTION

On the basis of the output of the factories canvassed it is estimated that the number of garage doors made yearly is approximately 1,150,000. On the same basis, however, only 14 per cent of the total number are constructed with partition panels. Hence an annual consumption of 2,000,000 board feet of ceiling and partition lumber is a reasonable estimate.

#### POSSIBLE EXTENSION OF USE OF SHORT LENGTHS

The lengths used for panels are all under 8 feet. According to the companies reporting, 20 per cent of these lengths are bought in specified and 5 per cent in random short lengths. Certain factories making a large proportion of all garage doors buy half or more of their partition material cut to length, and it is such factories that offer the most immediately promising market for shorts.

#### INCUBATORS AND BROODERS

The manufacture of incubators and brooders is a seasonal industry, being most active during the fall and winter months. The individual units in the industry are small, comparatively few requiring more than half a million feet of lumber yearly. The units are distributed over the whole country but are more numerous through the North Central States than elsewhere.

Despite the fact that wood is the chief raw material, the factories are assembling plants quite as much as they are woodworking plants. A large part of the output is in a few standard sizes. The lumber requirements are met with a few standard items, and shorts cut to length and bundled are utilized.

Incubators and brooders made entirely of metal and others of wood sheathed with metal and lined with fiber board have appeared on the market in recent years. The most common type, however, is made entirely of wood except for the metal and glass fixtures.

#### GENERAL SCHEME OF CONSTRUCTION

The all-wood incubator is composed of an outer box with an inner lining. The outer box is sometimes made from pieces 12 inches



wide, but more often five-eighths by 4-inch ceiling or 4/4 by 4-inch flooring is used. The lining may be of the same material or of 4/4 lumber resawed.

## LUMBER CONSUMPTION

From data obtained in the course of these studies it is estimated that the manufacture of incubators and brooders consumes 11,000,000 feet of lumber yearly. The wood should hold its shape and resist warping, work well, be reasonably durable, and in addition have moderate nail and screw-holding ability and be capable of taking a good finish.

The principal hardwoods used in the construction of incubators and brooders are yellow poplar, chestnut, and basswood, the total consumption being approximately 1,000,000 board feet per annum.

## CONSUMPTION OF SOFTWOODS BY SPECIES AND ITEMS

The softwood species used in the manufacture of incubators and brooders, listed in the order of their importance, are:

	Per cent
Redwood.....	58
Cypress.....	16
Southern yellow pine.....	10
Fir.....	9
Cedar.....	5
Northern pine.....	2

The following items of lumber are purchased:

	Per cent
Dressed, square edged.....	41
Rough.....	32
Flooring.....	12
Ceiling.....	8
Shop.....	5
Miscellaneous.....	2

The more detailed requirements as to sizes and grades, by species, are set forth in the following list.

## Redwood:

- 4/4" x 6"-12"; Clears and Selects; rough or dressed.
- 4/4" x 3", 4", and 6"; Clears; ceiling.
- 4/4" x 3", 4", and 6"; Clears; dressed and matched.
- 4/4" x random widths; Shop.

## Cypress:

- 4/4" x random widths; No. 2 Common and Better; rough.

## Southern yellow pine:

- 4/4" x 6" and wider; B and Better; S2S.
- 4/4" x 4"; D and Better; flooring.

## Douglas fir:

- 5/8" x 4"; No. 3 Clear and Better; ceiling.
- 4/4" x 4"; No. 3 Clear and Better; flooring.

## Cedar:

- 4/4" x 4"; Clear; ceiling.
- 4/4" x 6"-10" Clear; S2S.

## LENGTHS PURCHASED

Lengths of 8 feet and up comprise 63 per cent of all the softwood lumber used, specified short lengths 31 per cent, and random short lengths 6 per cent.



ITEMS BOUGHT IN SHORT LENGTHS

The following items are purchased in lengths less than 8 feet:

Redwood:

- 4/4" x 4" and wider; Clear; rough or dressed.
- 4/4" x 4" or 6"; Clear; dressed and matched, or ceiling.
- 8/4"; Clear; squares for legs.

Douglas fir:

- 5/8" x 4"; No. 2 Clear and Better; ceiling.
- 4/4" x 4"; No. 2 Clear and Better; flooring.

Cedar:

- 4/4" x 4" and wider; Clear.
- 4/4" x 4"; Clear; ceiling.

CUTTING LENGTHS

Though there is considerable difference between the largest and smallest apparatus made, most of the demand is for sizes requiring cutting lengths between 24 and 42 inches.

POSSIBLE EXTENSION OF USE OF SHORT LENGTHS

There are few products for which short lengths make up as large a proportion of the total number purchased as they do for incubators and brooders. This is due partly to the cutting requirements and partly to the fact that short lengths have been offered at satisfactory prices. Practically all of the requirements of the industry can be met by short lengths. The use of shorts is facilitated by good manufacture at the sawmill, which eliminates the waste at the consuming plant, and by bundling, which eliminates excessive handling costs. It is customary to allow an inch or so for trimming to exact lengths in the factory, and some of the very shortest material is purchased in multiples of the final lengths rather than in exact lengths.

SOURCES OF LUMBER

Of the lumber used in the manufacture of incubators and brooders 82 per cent is purchased from mills, 12 per cent from wholesalers, and 6 per cent from retail dealers.

TANKS AND VATS

Great numbers of tanks are used in the industries for water-storage and fire-protection systems, also for pickling and for holding acids, chemicals, and brine. On farms tanks are needed in connection with windmills for domestic water and for watering stock. The manufacture of tanks is frequently combined with the manufacture of silos, windmills, woodenware, cooling towers, or other products.

LUMBER CONSUMPTION

It is estimated that the manufacture of tanks, vats, and silos consumes 195,000,000 board feet of lumber yearly. Softwoods comprise 97 per cent of this, and hardwoods, mostly oak, 3 per cent. On the basis of the records of the plants included in the study it is estimated that two-thirds of the total is used for silos. Silos made of

short lengths extending horizontally are on the market, but in general the quantity of shorts used is negligible. There can be little doubt that the use of wood for windmills is decreasing; nevertheless it offers an outlet for a certain quantity of ready-cut stock such as that illustrated in Figure 5. The following data apply only to tanks

and vats, which are estimated to consume 59,000,000 feet of softwood yearly.

#### PROPERTIES REQUIRED IN THE LUMBER

The general properties required in lumber for tanks and vats are durability, imperviousness to liquids, strength, and stability. For some purposes it is also necessary that the wood resist the action of chemicals and be free from taste, odor, or color that will leach out. For the sake of durability it is desirable that heartwood be used;



FIG. 5.—Cut stock for tank and windmill manufacture. Although metal is used to a large extent for these products (which are frequently made in the same factory), it is estimated that 59,000,000 feet of softwoods is used yearly.

and though the material need not necessarily be clear, the knots should be small, sound, and tight. An important property of wood in tank construction is its insulating value against heat and cold.

Several lumber associations prescribe special tank grades which provide for high-quality material, sapwood usually being excluded or reduced to a minimum, and no coarse, unsound defects being admitted.

#### CONSUMPTION OF SOFTWOODS BY SPECIES AND ITEMS

The species used are as follows, in order of importance: Cypress, Douglas fir, southern yellow pine, redwood, white pine, cedar, and spruce.

Lumber for tanks and vats is bought in two forms: Rough, 84 per cent; dressed, 16 per cent.

#### SIZES PURCHASED

Tank stock is customarily bought in thicknesses of 2 inches and upward, widths of 6 inches and upward, and lengths of 8 feet and upward. Lengths of 8 feet and upward comprise 98 per cent of the total demand, and specified short lengths the remaining 2 per cent.

#### ITEMS BOUGHT IN SHORT LENGTHS

The following items are typical of those bought in short lengths:

- 8/4" x 6" x 2'; Clear redwood.
- 8/4" x 6" x 3'; Clear heart cypress.

#### CUTTING LENGTHS

Tanks and vats require from 2 to 20 foot lengths. The larger the product the thicker the lumber used. In round tanks the sides are made of staves extending up and down, but in rectangular tanks or vats lumber in the sides and ends extends horizontally. Tanks for stock watering probably represent quantity production in standard sizes more nearly than any other type. These are circular and are 2 or 2½ feet in height by 8 to 12 feet in diameter.

#### POSSIBLE EXTENSION OF USE OF SHORT LENGTHS

Manufacturers of industrial tanks need lengths greater than 6 feet for nearly all their staves. Consequently a surplus of short lengths is accumulated in their own cutting operations. So wide is the variety in sizes and types of tanks in demand that the requirements of the trade can not be anticipated, and scarcely any tanks are made in advance of orders. As a result the lumber is purchased in sizes suitable for the largest tanks for which the demand is considerable, on the ground that the quantity of stock necessarily kept on hand is reduced. The most immediately promising field for expanding the use of shorts is the manufacture of stock tanks of the type illustrated in Figure 6. Although a few companies already are buying some of their lumber of this purpose in shorts, a much larger proportion of it could be so bought.

#### SOURCES OF LUMBER

The tank and vat lumber covered in this report is purchased from the following sources:

Source	Per cent
Mill.....	61
Wholesale.....	26
Retail.....	13

#### AUTOMOBILE RUNNING BOARDS AND FLOOR BOARDS

The discussion of softwoods for automobile construction is limited in this circular to running boards and floor boards. These two items in fact constitute almost the only uses for softwoods (aside from shipping requirements) in the automobile industry, and are among the few parts which are not cut to special forms.



They may be made from standard items of lumber by ordinary machine methods. Running boards are not generally considered part of the automobile body as manufactured at body factories and are more often made in separate plants.

#### METHODS OF CONSTRUCTION

Information on the production of running boards was collected from 29 automobile manufacturers in 1923. Six of the 29 used metal, 8 bought finished running boards cut to size, and 15 bought lumber and manufactured this item. At first running boards were frequently made in one piece, but now it has become customary to make them of two or three pieces, which are tongued and grooved or else joined on the Linderman machine. The floor boards are either of separate pieces or are joined together either on the Linderman machine or otherwise.

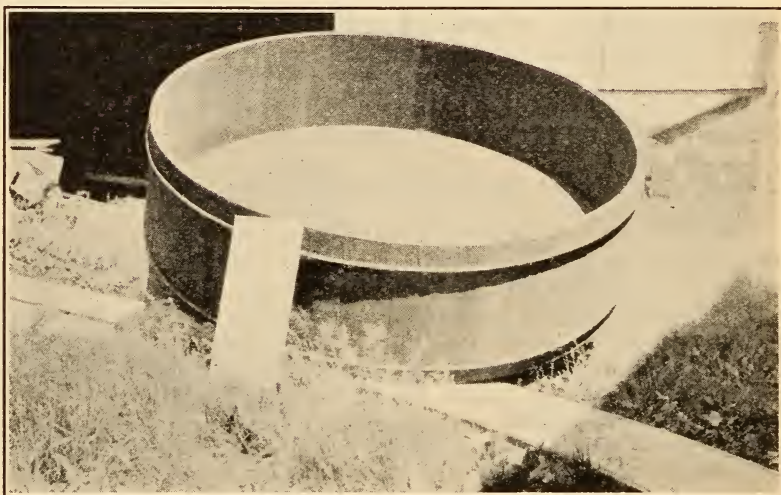


FIG. 6.—Short lengths for tank stock. Stock-watering tanks are fairly well standardized in size, and manufacturers often buy short rough clears for the staves

#### LUMBER CONSUMPTION

On the basis of the annual output of motor cars, it is estimated that at least 37,500,000 feet of lumber is required yearly for use in the manufacture of running boards and floor boards. Seven and one-half million feet of this material is hardwood and 30,000,000 feet is softwood.

#### COMPARATIVE CONSUMPTION OF SOFTWOODS BY SPECIES AND ITEMS

According to the figures collected in 1923, southern yellow pine makes up 81 per cent of the softwoods used for running boards. The other softwoods, in order of importance, are spruce, cypress, fir, Port Orford cedar.

Most of the lumber is purchased dressed and square edged. No. 1 Common is the poorest grade reported as used and B and Better the best. The lower grade is used in larger amounts.

## LENGTHS PURCHASED

The lumber is purchased in lengths ranging from 6 to 20 feet. Comparatively little of it, however, is under 8 feet or over 16 feet.

## ITEMS BOUGHT IN SHORT LENGTHS

Some of the shorts are 1 by 6 inch lumber, but the larger part of the short material is bought in the form of ready-cut stock. Some companies have discontinued the use of ready-cut stock because it was poorly manufactured or because they were unable to get as prompt shipments as they desired.

## CUTTING LENGTHS

The shortest length reported for running boards is 48 inches and the longest 84 inches. Sixty inches or thereabouts is the commonest length. The width varies from 10 to 13 inches and the thickness from three-quarters to seven-eighths inches, three-quarter-inch predominating. Floor boards vary in length from 29 to 36 inches.

## POSSIBLE EXTENSION OF USE OF SHORTS

The best chance of marketing shorts for running and floor boards appears to be through making dressed blanks of the desired size at the mill. Since the exact requirements of the final product are familiar only to the automobile manufacturer, the final machine work may very well be left to him.

## SCREEN DOORS

Manufacturers of screen doors purchase for the most part long lengths of lumber which are cut to size in the process of fabrication. The sizes of the finished doors are sufficiently standardized to allow of manufacture on a quantity-production basis.

## GENERAL SCHEME OF CONSTRUCTION

Screen doors are made in several types, differing chiefly in the number and arrangement of parts. All types have at the sides two vertical members, called stiles, and at the top and bottom two cross members called rails. There are generally several other parts, the number and arrangement depending partly upon the design and partly upon the size and quality of the product. Dowels are the means of fastening most frequently used.

## LUMBER CONSUMPTION

From the data obtained in these studies it is estimated that 20,000,000 feet of softwood lumber is annually consumed in the manufacture of screen doors. Hardwoods are used to a considerable extent for window screens, but the quantity worked into screen doors is relatively small.

## PROPERTIES REQUIRED IN THE LUMBER

There is a wide variation in the properties of the different softwoods used for making screen doors and in the quality of the finished

doors themselves. Most screen doors, however, are made of wood possessing in a reasonable degree the following properties: Nail-holding ability, durability, workability, and stability of form and size.

#### CONSUMPTION OF SOFTWOODS BY SPECIES

The principal species used are southern yellow pine, western yellow pine, northern white pine, and cypress. These woods are bought either in the select grades or in the upper shop grades.

#### LENGTHS AND ITEMS PURCHASED

The lumber is purchased almost entirely in lengths of 8 feet and up, the principal thickness being  $4/4$  inch, with some heavier material. The widths are 4 inches and wider. It is reported that 38 per cent of the lumber is bought rough and 62 per cent dressed square edged.

#### ITEMS BOUGHT IN SHORT LENGTHS

The only size reported as bought in short lengths is southern yellow pine 1 by 4 inches by 7 feet. This is used for stiles (the upright members), which are the longest cuttings in the door. When long lumber is cut up the first object is to get as many stiles as possible, and in so doing an excess of short cuttings is unavoidably produced.

#### CUTTING LENGTHS

Stiles are usually 3 or 4 inches in width and from 6 feet 8 inches to 7 feet 2 inches in length. Rails (horizontal pieces) are usually 2, 3, 4, or 5 inches wide and from 2 feet 4 inches to 2 feet 10 inches in length.

#### POSSIBLE EXTENSION OF USE OF SHORT LENGTHS

Owing to the fact that in cutting the stiles an excess of smaller cuttings is produced, the alternatives open for obtaining more economical utilization of wood seem to be either purchasing all material from the mill in the form of ready-cut stock, or purchasing standard lengths from the mill, together with enough stiles to maintain a proper balance.

#### STEPLADDERS

Stepladders are manufactured in plants consuming from a few carloads to several million feet of lumber yearly. Frequently extension ladders, lawn swings, woodenware, and other more or less related products are manufactured in the same plant. Although there are slight variations in the details of stepladders as made by different concerns, in general the construction is so similar that description is unnecessary.

#### LUMBER CONSUMPTION

From data obtained in the present studies it is estimated that the manufacture of ladders consumes approximately 30,000,000 feet of lumber yearly, and that stepladders require one-half of this quan-



tity, or 15,000,000 feet, of which 13,000,000 are softwoods. Hardwood is largely used for the short combination chair-and-stepladder often seen in household service.

#### PROPERTIES REQUIRED IN THE LUMBER

In general, the properties sought in lumber for stepladders are lightness, stiffness, and strength. Strength is perhaps less important in stepladders than in extension ladders, because the former can be braced and reinforced more easily.

#### CONSUMPTION OF SOFTWOODS BY SPECIES AND ITEMS

Spruce is the species most commonly used. Southern yellow pine, western hemlock, and Norway pine are also in demand in about equal quantities.

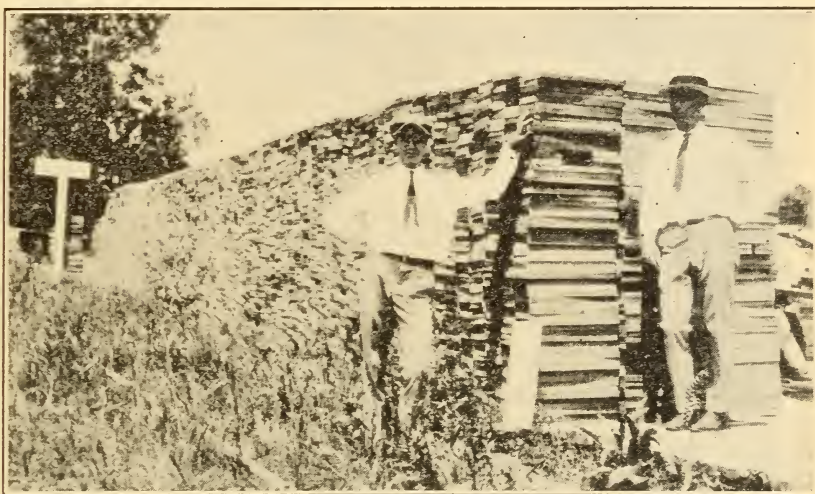


FIG. 7.—Clear stock cut to length and bundled for manufacture of stepladders. Edges are already rounded or beveled when bought. Of the 13,000,000 feet used for stepladders, 66 per cent is used in short lengths, but only 20 per cent is bought in shorts

Sixty-three per cent of the lumber consumed is purchased dressed, 24 per cent rough, and 13 per cent machined to pattern. Only the highest grades are acceptable.

#### LENGTHS PURCHASED

Lengths of 8 feet and over make up 80 per cent of the quantity of lumber purchased, specified short lengths 14 per cent, and random short lengths 6 per cent.

#### ITEMS BOUGHT IN SHORT LENGTHS

Short-length material for 4, 5, and 6-foot stepladder sides, steps, and braces is bought rough, dressed, or machined to pattern, in sizes of 1 by 2, 1 by 3, and 1 by 4 inches. The woods so purchased are southern yellow pine and western hemlock. Figure 7 shows part of

a large stock of ready-cut and specially machined material in storage awaiting manufacture into stepladders.

#### CUTTING LENGTHS

Nearly all material for sides and braces is used in lengths of 4 to 10 feet. Steps and tops, which comprise about one-third of the lumber used, range from 12 to 22 inches in length.

#### POSSIBLE EXTENSION OF USE OF SHORT LENGTHS

On the basis of the number of plants canvassed in this study it appears that half the industry finds it possible to buy at least a part of its material in lengths under 8 feet. The general opinion seems to be that for sides and braces for the shorter stepladders such material is very satisfactory. It is quite evident that the point of saturation has not yet been reached, since some manufacturers report difficulty in obtaining as much short material as they can use. Step material could all be bought in short lengths, which, together with sides and braces for the shorter ladders, comprises two-thirds of the total lumber requirement of the industry.

#### SOURCES OF LUMBER

Eighty-four per cent of the lumber consumed is purchased from mills, 12 per cent from wholesalers, and 4 per cent from retailers.

#### ADVERTISING SIGN PANELS

Concerns engaged in the manufacture of advertising signs or billboards vary in importance from regional organizations consuming millions of feet of lumber yearly to small local establishments using a few hundred thousand feet. There are two general classes of companies concerned: (1) Commercial advertising companies building, installing, and owning the billboards and renting advertising space, and (2) those which make and sell completed signs of smaller size on a quantity scale.

#### GENERAL SCHEME OF CONSTRUCTION

At one time billboards were constructed largely of wood in both framing and body. Now, however, the solid-wood billboard or large sign is comparatively rare. Panels as now made consist of a light wooden frame covered with sheet metal on which the sign is painted or the bill posted. The supporting and bracing members are of heavier material. Figure 8 shows the framing and bracing of a typical sheet-metal billboard of the present day. Certain companies use metal supports and braces in all their construction, and the use of metal for those purposes is general in areas of high-fire hazard and for roof signs.

The wood used in billboards and advertising signs may be divided into three general classes: The framing and brace lumber, which constitutes about 64 per cent of the total; the panel lumber, 21 per



FIG. 8.—Back of typical billboard, showing use of short lengths in panel and grille construction



cent; and the moldings, 15 per cent. Of these the lumber used in the panels is the only item of interest as a market for shorts.

#### LUMBER CONSUMPTION

Despite the substitution of metal, the total quantity of wood used for commercial signs has increased during recent years, and, on the basis of information furnished by the companies canvassed, an annual consumption of 30,000,000 board feet is estimated for billboard panels and smaller signs. The use of hardwoods in advertising signs has not been reported, though the market is not necessarily closed to them.

#### PROPERTIES REQUIRED IN THE LUMBER

The requirements of lumber for use in billboard panels and advertising signs are not exacting, the chief requisites being stability of form and size and moderate strength and nail-holding ability. In large billboards a reasonable degree of durability is also desirable, but in the smaller advertising signs this factor is of less importance.

#### CONSUMPTION OF SOFTWOODS BY SPECIES AND ITEMS

*Frame and brace lumber.*—Both southern yellow pine and hemlock in the grade of No. 1 Common are used for frames and bracing, though southern yellow pine is used to the greater degree. The thickness varies from 2 to 4 inches and the width from 4 to 8 inches. Usually 16-foot lengths are purchased. Most of this lumber is standard-dimension material. Requirements are not exacting, and price and availability govern the choice.

*Panel lumber.*—White pine appears to be the favorite lumber in use for metal-covered panels, with shortleaf pine second in popularity. Panel lumber is bought S4S in 4/4 thickness. The widths vary from 2 to 6 inches and the lengths from 2 to 16 feet. The grades used are No. 1 Common and Better.

*Moldings.*—Redwood is reported as being used for moldings, more largely than any other wood, although there is some demand for Douglas fir for this purpose.

#### LENGTHS PURCHASED

Sixty-four per cent of all lumber used in the panels of billboards and covered signs is purchased in lengths of 8 feet and up. The remaining 36 per cent is bought in specified lengths of less than 8 feet.

#### ITEMS BOUGHT IN SHORT LENGTHS; CUTTING LENGTHS

The following items are bought in lengths of less than 8 feet:

4/4" x 4"; No. 1 Common and better; white pine, S4S.

4/4" x 3" and 4/4" x 2"; No. 1 Common; yellow pine, S4S.

Lengths vary from 2 to 6 feet. In the smaller advertising signs all requirements can be met with shorts.

#### POSSIBLE EXTENSION OF USE OF SHORT LENGTHS

Since the sizes of billboards are to a large extent standardized, it is possible to meet a considerable proportion of the panel requirements by material cut to size.

Apparently the larger commercial advertising companies are inclined to use short lengths to the fullest extent possible. Any increased use, therefore, would probably be on the part of smaller local concerns and those making completed signs, including small wooden fence signs, for sale to the advertiser.

#### SOURCES OF LUMBER

Nearly 100 per cent of the panel lumber consumed by the companies visited was purchased direct from the mill.

#### WASHING MACHINES

The manufacture of washing machines for domestic use is an industry which has expanded greatly during recent years. So far as wood consumption is concerned, however, the expansion has been to some extent offset by an increasing proportion of metal construction. Nevertheless wooden tubs still form an important item in the industry.

Several distinct types of washing machines are on the market, but only two, the dolly and the cylinder types, are of interest in this study. They are the kinds by far the most commonly made and are more nearly of all-wood construction than the others.

#### GENERAL SCHEME OF CONSTRUCTION

From a woodworking standpoint the most important part of the machine is the tub. This is made of staves, usually  $\frac{4}{4}$  inch in thickness and 4 or 5 inches wide. Staves are generally bought in the form of rough blanks which are machined to form at the plant. The bottoms and covers of the tubs are usually made of the same wood as the staves. The supporting frame or legs vary in construction and may be of metal, hardwood, or softwood.

The cylinders and dollies are inner revolving parts used in the two different types of machines. They are commonly of hardwoods, especially the dollies.

#### LUMBER CONSUMPTION

From data collected in this study it is estimated that the manufacture of washing machines consumes at least 21,000,000 board feet yearly, 14,000,000 of which is softwood lumber.

#### PROPERTIES REQUIRED IN THE LUMBER

To render satisfactory service in tubs the softwoods used should be durable, that is, of clear heart material. The wood should be free from pitch pockets, should machine well, should resist abrasion in use, and should not splinter, warp, swell, or shrink excessively.

#### CONSUMPTION OF SOFTWOODS BY SPECIES AND ITEMS

On the basis of information obtained at the plants studied it appears that cypress is the wood in heaviest demand for tubs. Other softwoods used in varying quantities are southern white cedar, white

pine, southern yellow pine, Port Orford cedar, and Douglas fir. The lumber was bought in the following items and proportions:

	Per cent
Rough.....	90
Dressed.....	5
Shop.....	3
Dressed and matched.....	2

A large part of the rough lumber is cypress stave blanks.

#### LENGTHS PURCHASED

The lengths in which the lumber is purchased may be classified as follows:

	Per cent
Specified lengths under 8 feet.....	58
Lengths of 8 feet and over.....	25
Random lengths under 8 feet.....	17

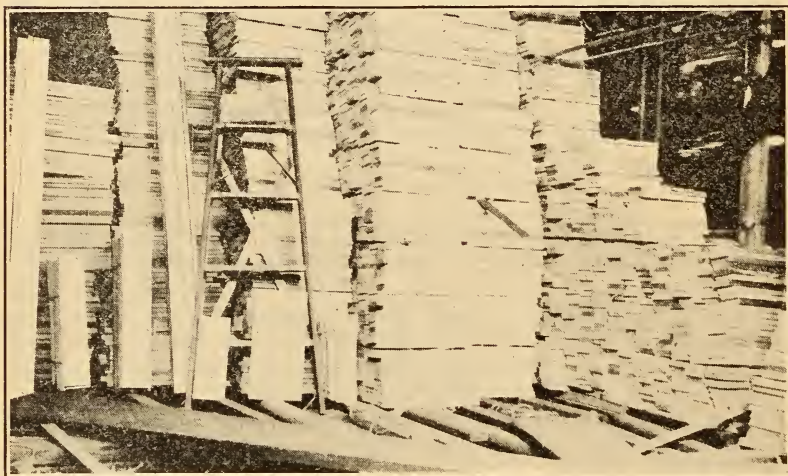


FIG. 9.—Washing-machine tub-stave blanks at a southern cypress mill. It is estimated that 14,000,000 feet of softwood is used yearly for this purpose, despite the inroads of metals. Seventy-five per cent of the wood is bought in short lengths, including 58 per cent cut to exact size

#### ITEMS BOUGHT IN SHORT LENGTHS; CUTTING LENGTHS

Rough stave blanks cut to size are the main items bought in short lengths. There is some slight variation in practice between factories, but the sizes used are in general quite similar. For staves,  $4/4$  by 4 by 15 inches is probably the commonest size. Legs are often made from staves 28 to 32 inches in length. For tops and bottoms,  $4/4$  by 6-inch material in lengths of 16 and 24 inches may be considered typical. One inch is by far the most important thickness for all parts, although some  $5/4$ -inch material is used. Widths vary from 3 to 7 inches and lengths from 15 to 32 inches. Contrary to practice in most other lines, the shorts are not usually bundled. Figure 9 shows a typical lot of cypress stave material awaiting shipment from a southern mill.



POSSIBLE EXTENSION OF USE OF SHORT LENGTHS

On the basis of the present study it appears that 100 per cent of the lumber is used in short lengths and that 75 per cent of it is actually bought in short lengths. No important increase in the use of shorts in this industry can, therefore, be reasonably expected unless it is possible to increase the consumption of wood at the expense of metal, and the present trend in the industry appears to be in the opposite direction. Some manufacturers report difficulty in getting lumber of the quality desired, and it seems likely that wood will continue to lose ground unless this obstacle can be removed.

SOURCES OF LUMBER

Of the lumber consumed in the manufacture of washing machines, 95 per cent is obtained from mills, 4 per cent from wholesalers, and 1 per cent from retailers.

BEEHIVES

The manufacture of beehives is a relatively small industry but is of interest in this study because the cuttings used are all short.

LUMBER CONSUMPTION

About 15,000,000 board feet of lumber is required annually for beehive manufacture. Approximately one-third of this quantity is basswood, which is bought in the grades of No. 1 and 2 Common. The remainder is softwood. Almost all honey sections are made of basswood. In some hives the inner covers and certain other parts are of basswood and the exterior of softwood.

PROPERTIES REQUIRED IN THE LUMBER

For use in the manufacture of beehives the wood should be easy to work, should hold its shape well, take paint well, and be durable.

CONSUMPTION OF SOFTWOODS BY SPECIES AND ITEMS

Among softwoods the soft pines are the most favored for hive construction. The preferred species in approximate order of importance are sugar pine, northern white pine, Idaho white pine, and western yellow pine. The pines are bought in about the same grades and sizes, namely 4/4 lumber, 6 inches and upward in width, and in random lengths. The grades are No. 1 Common and Shop. Other softwoods used in beehives, though to a less extent, are cypress, cedar, and redwood. The principal use of cypress is for bottom boards. It is bought in random widths, 4/4 inch by 6 inches and wider, in grades of No. 1 Shop and No. 1 Common. Redwood is bought mostly in Clear and Shop grades and in sizes of 4/4 inch by 10 inches and wider. Its principal use is in bottom boards.

Eighty-five per cent of the lumber is bought dressed, 12 per cent rough, and 3 per cent worked to pattern.

## LENGTHS PURCHASED

Nearly all lumber used for beehives is bought in lengths of 8 feet and over; only 3 per cent of the total is bought in random short lengths and 2 per cent in shorts cut to specified sizes.

## CUTTING LENGTHS

Despite the almost invariable custom in the industry of buying long lengths, the study shows that beehive materials are used very largely in lengths ranging from 14 to 22 inches. The most common widths required are 5, 6, and 10 inches.

## POSSIBLE EXTENSION OF USE OF SHORT LENGTHS

Although only a small part of the total lumber consumed is at present bought in short lengths, it is apparent that, as far as cutting sizes are concerned, all requirements might be met by short lengths.

## AGRICULTURAL IMPLEMENTS

Under agricultural implements, as the term is here used, are included such articles and apparatus as harvesters, threshing machines, seeders, and mowers. Their manufacture is carried on to some extent in nearly all sections of the country but is largely centralized in the Northeastern and North Central States. This is one of the larger wood-using industries.

## LUMBER CONSUMPTION

The lumber consumption of the farm-implement industry has undergone radical changes in recent years. There has been a gradual shifting from hardwood to softwood and from wood to metal. Some implements are all-metal except for such parts as tongues, eveners, and other accessories.

It is estimated that the annual consumption of the industry is 228,000,000 board feet, of which softwoods make up 130,000,000 and hardwoods 98,000,000.

## PROPERTIES REQUIRED IN THE LUMBER

In general the lumber used by this industry needs to have strength, toughness, and ability to resist wear.

## CONSUMPTION OF SOFTWOODS BY SPECIES AND ITEMS

The total softwood consumption is divided approximately as follows:

	Per cent
Southern yellow pine.....	55
Douglas fir.....	27
White pine.....	7
Cypress.....	4
Redwood.....	3
Larch.....	2
Miscellaneous.....	2

Of all softwoods used, 93 per cent is purchased in standard sizes and patterns and 7 per cent as special items. The softwood products and the extent of their use may be itemized as follows:

	Per cent
Dressed lumber, 4/4"-----	51
Material 8/4" and thicker-----	32
Flooring-----	12
Other worked items-----	5

Classification by grades of the softwoods consumed is as follows:

	Per cent
Select grades-----	83
No. 1 Common-----	12
No. 2 Common-----	4
Below No. 2 Common-----	1

#### LENGTHS PURCHASED

Lengths of 8 feet and over constitute 92 per cent of the lumber purchased. The 8 per cent purchased in short lengths may be subdivided as follows:

	Per cent
Standard sizes and patterns-----	76
Special sizes and patterns-----	24

#### CUTTING LENGTHS

To afford an idea of the relative importance of different cutting lengths in the farm-implement industry, 21 typical cutting bills were analyzed. These bills represented a total of 1,200 pieces, covering all types of agricultural implements. The results of the analysis were as follows:

Length:	Per cent
Under 3 feet-----	55
3 to 4 feet-----	16
4 to 5 feet-----	8
5 to 6 feet-----	4
6 to 7 feet-----	2
7 to 8 feet-----	6
Over 8 feet-----	9

#### POSSIBLE EXTENSION OF USE OF SHORT LENGTHS

Farm implements comprise a very wide range of products, which require cuttings in an endless variety of sizes, species, and qualities. Many of the implements, however, are made in small volume at the average factory, and consequently a great many of the cutting sizes are in relatively small demand. Furthermore the small cuttings are often of special design. For these reasons it would be difficult to supply small cuttings satisfactory to the industry. Nevertheless a beginning has been made in the manufacture of blanks at the mill in exact lengths or multiples for further manufacture at the consuming plant.

#### COMMERCIAL FIXTURES

Commercial fixtures include such products as show cases, counters, partitions, cabinets, and miscellaneous appointments for more or less permanent installation in stores, banks, hotels, and other places of business.



## LUMBER CONSUMPTION

It is estimated that the manufacture of commercial fixtures consumes approximately 145,000,000 feet of lumber yearly. Of this quantity 16 per cent, or in round numbers 23,000,000 feet is softwoods.

Birch, oak, basswood, poplar, chestnut, and maple, in the order mentioned, meet 75 per cent of the hardwood requirements. The pines make up more than half of the softwoods used, the other species being hemlock, cypress, red cedar, spruce, fir, and redwood. The most important uses of softwoods are in shelving, backing, drawers, and interior work, for which grades of No. 1 and No. 2 Common are generally preferred. When softwoods are used in parts where appearance is a consideration, Select or Clear grades are required, although a certain number of small clear cuttings are made from Shop grades.

## USE OF SHORT LENGTHS

Judging from the numerous cutting bills analyzed, only 7 per cent of the cuttings used are in lengths of 8 feet or over. Nevertheless on account of the wide range of products represented, most of which are special, and the relatively small percentage of softwoods used, commercial fixtures offer less promising outlets for short lengths than most of the other industries here considered.

## TOYS

Wooden toys range in size from jackstraws to boys' wagons. The toys which are of greatest concern here, as offering the best potential outlets for short-length lumber, are wagons, sleds, and furniture. They are comparatively staple products, made from year to year in relatively large volume, and in this respect are distinguished from novelties which sell for one or two seasons and then practically disappear. They are also, as a class, the largest toys and take the largest cuttings.

## LUMBER CONSUMPTION

It is estimated that the quantity of lumber annually consumed in the manufacture of toys is 23,000,000 board feet. Of this quantity only 10 per cent is softwoods. Three-fourths of the companies reporting state that they use no softwoods whatever, aside from box and crate lumber.

## CONSUMPTION OF SOFTWOODS BY SPECIES AND ITEMS

The pines are by far the most important softwoods used in the toy industry. Northern white pine, western yellow pine, and southern yellow pine are commonly used. Relatively small quantities of cypress and Douglas fir are also reported.

The bulk of the softwood lumber is purchased in 4/4-inch thickness, together with some 6/4 and 8/4 inch, in grades of No. 1 Common and Better. The widths vary from 6 inches upward. Some New England manufacturers report the purchase of mill-run white pine, and in some instances the Shop grades are used.

The items purchased were in the following proportion:

	Per cent
Rough.....	55
Dressed.....	31
Shop.....	14

#### LENGTHS PURCHASED

Lengths of 8 feet and up comprise 85 per cent of the lumber purchased; short lengths, consisting largely of stock cut to size, make up the remainder.

#### ITEMS BOUGHT IN SHORT LENGTHS

The random-length shorts used in the toy industry are largely white pine from Canada. "Canadian shorts" form a special classification in the trade on account of their lengths, which run from 6 to 9 feet, inclusive, an average of 50 per cent of the pieces being 6 or 7 feet long.

Shorts purchased in specified lengths are all cut to size for some definite toy and vary considerably between different plants. A typical order, as recorded at one plant, calls for the following pieces:

- $\frac{5}{8}$  by 5 by 13 inches.
- $\frac{5}{8}$  by 12 by 36 inches.
- $\frac{5}{8}$  by 4 by 36 inches.
- $\frac{1}{2}$  by 4 by 36 inches.
- $\frac{7}{8}$  by  $4\frac{3}{4}$  by 22 inches.

The material called for in the above bill is all square-edged, S2S, and is really a form of dimension stock rather than standard lumber.

#### CUTTING LENGTHS

A profusion of cutting lengths obtains, but very little lumber is used in lengths greater than 3 feet.

#### POSSIBLE EXTENSION OF USE OF SHORT LENGTHS

Toys are often thought of as offering a good market for short lengths, and as far as cutting sizes are concerned it is true that all requirements can be met by shorts. Certain practical difficulties, however, limit their use, chief among which are greater waste in cutting in toy manufacture as compared with other industries, and greater handling costs. The increased use of short lengths in the manufacture of toys therefore depends largely on careful manufacture and shipping, and on the price.

#### SOURCES OF LUMBER

The lumber covered by this survey is purchased from the following sources in the proportions shown:

	Per cent
Mills.....	95
Wholesalers.....	4
Retail dealers.....	1

#### CABLE REELS

The wooden reels on which electric cable and wire rope are wound in shipment constitute a possible outlet for short lengths in the common grades. Nearly all companies having use for such reels buy the lumber and make them in their own plants.

## GENERAL SCHEME OF CONSTRUCTION

The reel is composed of a central section or barrel and two heads. The barrel is usually made of material from 2 to 4 inches thick and from 1 to 4 feet long. The heads are generally made of two or more plies of 4/4 material, in lengths from 2 to 6 feet. After the cable is reeled on, a casing of heavy material is sometimes put on the outside. For the heavier telephone cables and the like (see fig. 10) the whole drum is of very rugged construction to allow for the severe conditions of shipping and service which it must undergo.

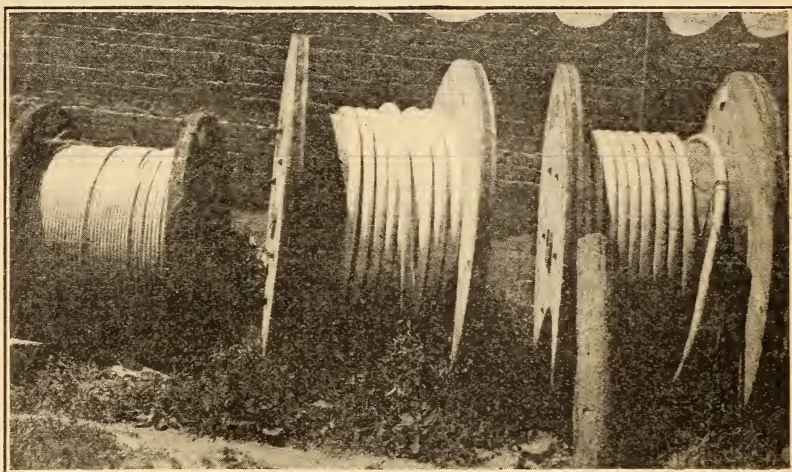


FIG. 10.—Reels for electric cable, wire rope, etc. This use is estimated to require over 13,000,000 feet of softwoods yearly, 90 per cent of which is used in short lengths. Only 3 per cent, however, is bought in that form

## LUMBER CONSTRUCTION

On the basis of the study here reported it is estimated that the construction of cable reels and drums requires 21,000,000 feet of lumber yearly, of which 64 per cent is softwood.

## CONSUMPTION OF SOFTWOODS BY SPECIES AND ITEMS

The species, grades, and sizes of softwoods purchased are reported as follows:

## Spruce:

Merchantable; 4/4" x 6"-9"; 8/4" x 9"; 2" x 3"; 4" x 4".

## Southern yellow pine:

No 2, No. 3 Common; 4/4" x 4"-12"; 6/4" x 4"-12"; 8/4" x 4"-12".

## Northern white pine:

No. 1, No. 2 Common, Box; 4/4" x 6"-12"; 5/4" x 6"-8"; 8/4" x 6"-12".

## Cypress:

No. 1, No. 2 Common; 4/4" x 6"-12".

## Hemlock:

No. 1, No. 2 Common; 4/4" x 6"-12"; 2" x 3"; 4" x 4".

## POSSIBLE EXTENSION OF USE OF SHORT LENGTHS

Only one-third of the companies canvassed reported the use of any cuttings as long as 8 feet, and the great bulk of the cuttings are not



over 6 feet long. Only one company, however, buys any substantial proportion of its requirements in short lengths. The weighted average for all companies shows that short lengths constitute only 6.3 per cent of their total requirements.

The cutting sizes would certainly permit the use of shorts, and it seems probable that random-length shorts would satisfactorily serve the purpose.

#### INDUSTRIAL USES FOR SHORT LENGTHS FOR WHICH ONLY GENERAL DATA WERE OBTAINED

The industries discussed in the preceding section were studied sufficiently to justify an estimate of their importance as outlets for shorts of No. 1 Common and Better quality, either worked to pattern or square edged. In addition there are numerous manufactures which present somewhat less certain markets for the class of shorts with which this circular is chiefly concerned. They are worth considering, however, on account of their large lumber consumption and because at present they consume a certain quantity of shorts, or their cutting sizes indicate that shorts might be used.

#### BOX AND CRATE MANUFACTURE

The manufacture of boxes and crates is distributed over virtually the whole country. It is a highly competitive business, not only as between different woods and different regions, but also as between wood and substitutes. The requirements of the industry are not, in general, exacting. This is plainly indicated by the fact that nearly all the native commercial woods are used to a greater or less extent for containers, usually in the lower grades. Nearly always protective utility rather than appearance is desired in the finished product, though occasionally consumers prefer a somewhat finer container and are willing to pay accordingly. The industry operates as a rule on the principle of quantity production. Some plants, however, manufacture comparatively small numbers of many sizes and kinds of boxes.

Many box factories, particularly in the soft pine regions, are operated in conjunction with large sawmills. Throughout the north-eastern section of the country large lumber dealers often maintain box factories in connection with their yards. For instance, of 20 yards with an average turnover of 23,000,000 feet each it was found that 6 maintained box factories. Factories operated independently of either yard or mill, however, doubtless outnumber all the rest.

Methods of factory operation vary widely in different regions. Factories on the west coast producing pine boxes use methods entirely different from either those of New England or those of the North Central States. Many companies, especially those with distant markets, ship their output in the form of shooks. Again, over short distances, it is very common to ship nested boxes; and where the factory and the consumer are located within the same city the boxes are delivered ready for use.

#### LUMBER CONSUMPTION

It is estimated that the manufacture of boxes and crates consumes annually 3,800,000,000 board feet of lumber, of which 1,100,000,000 feet is hardwoods and 2,700,000,000 softwoods.

## SOFTWOOD CONSUMPTION BY SPECIES AND ITEMS

The softwoods used for box and crate purposes, in order of importance, are as follows: Soft pines, southern yellow pine, spruce, hemlock, cypress, larch, fir, cedar, and redwood. Returns from 43 large box concerns throughout the North Central and Northeastern States indicate that 83 per cent of the lumber is purchased in rough form, 16 per cent dressed, and 1 per cent dressed and matched. This material is bought in the following thicknesses and relative amounts:

	Per cent
4/4 inch.....	48
More than 4/4 inch.....	44
Less than 4/4 inch.....	8

## LENGTHS PURCHASED

Ninety-one per cent of the total is bought in lengths of 8 feet and over and the remaining 9 per cent in lengths under 8 feet.

## CUTTING LENGTHS

Owing to the magnitude of the industry and the enormous variation in size of its products, the collection of detailed information as to cutting lengths was not attempted. It is a matter of general knowledge, however, that with a few exceptions such as the manufacture of piano boxes, automobile export boxes, and the largest dry-goods cases, the cuttings used are comparatively short. This point was discussed at some length with a number of manufacturers, and it was the consensus of opinion that very small percentages of their cuttings are shorter than 10 inches or longer than 40 inches.

## POSSIBLE EXTENSION OF USE OF SHORT LENGTHS

*Crating.*—One of the most promising outlets for short lengths of common quality appears to be dimension crating. Manufacturers of products which are customarily crated for shipment and for which only a few lengths of crating are required frequently find it desirable to buy the lumber already cut to size. Others buy it ripped to the desired width and allow the inclusion of lengths as short as 6 feet.

*Boxes.*—For the manufacture of boxes the use of shorts is decidedly unpopular. It is argued that their use must inevitably increase manufacturing costs considerably, even in factories making such a wide range of sizes that waste is minimized. Nevertheless there are factories purchasing several million feet of shorts yearly in lengths up to 47 inches. The shorts are bought by weight and sorted to lengths and widths by machinery. This system has proved entirely practicable where the supply of shorts is large and assured. If, as usually happens, a shortage of certain lengths and a surplus of others develop, it becomes necessary to buy some long lumber to maintain a balance. Despite that fact, the practicability, under favorable conditions, of a greatly increased use of shorts is being clearly demonstrated.

Most box lumber is dressed before being made up. Surfacers are not, as a rule, intended to handle very short material and do not do it satisfactorily. This difficulty is overcome in some instances by the use of surfacing machines of special design.

In brief, then, the successful use of shorts in box manufacture is largely a matter of proper equipment and satisfactory supply. There are possible outlets for 4/4-inch short lengths even in the largest types of boxes, but such uses require shooks rather than random-length shorts.

A few mills market their 6-foot box lumber by combining it with 8-foot lengths and selling the mixed product in straight carloads at a slight reduction in price.

#### THE RAILWAY-CAR INDUSTRY

The manufacture and repair of railway cars is carried on to some extent in all sections of the country, but its maximum development naturally coincides with the region of densest population and greatest per capita railroad mileage. The work is done in the shops of the railways themselves and in independent establishments.

*Railways.*—Practically all railways do a certain amount of car repairing, and in some cases they build cars also. Figures reported by 29 roads indicate that an average of 2,500,000 board feet of lumber is kept on hand for car construction and repair work.

*Car works.*—Besides the plants that turn out complete cars, there are some shops whose business is confined to repairs. Although car works vary considerably in size, this study indicates that 20,000,000 feet is a fair estimate of the average annual consumption of lumber at a single establishment.

#### CLASSES OF RAILWAY CARS

Exclusive of special-equipment rolling stock, railway cars are classed as passenger cars, which comprise less than 3 per cent of the total number, and freight cars. Under present methods of construction very little wood is used in passenger cars except small quantities of hardwood for interior trim; in this study, therefore, passenger cars are not considered.

According to figures published by the United States Department of Commerce, the number of freight cars in service in 1922, aside from those owned by private lines (i. e., lines of any description not common carriers) was 2,293,392. This number was divided as follows:

Box cars.....	1,021,516
Coal cars.....	939,251
Flat cars.....	99,032
Stock cars.....	80,680
Refrigerator cars.....	63,454
Others.....	89,459

Box cars are of principal interest here, both because they form a large part of the total and because they offer a more promising outlet for short lengths than do other kinds of cars, with the possible exception of refrigerator cars.



## METHODS OF CONSTRUCTION

The use of metal in box cars has increased in recent years until at present almost no all-wood cars are being built. Their importance as a type will end when those now in service wear out.

Nevertheless, wood is still used in box-car construction in varying quantities for sills, framing, decking, siding, lining, and roofing. In many cases the sills and framing are the only wooden parts which are given further manufacture at the car plant, but some of the larger car concerns purchase considerable quantities of their decking and similar items in the rough and do their own machine work. At one time there was heavy demand for 5-foot roofing, but since the adoption of steel-roof construction almost the only use of this item has been in repairing the older types of cars.

## CONSUMPTION

It is estimated that the present yearly lumber consumption for car repairs and construction is approximately 1,000,000,000 board feet. The quantity of softwoods is about 835,000,000 board feet and that of hardwoods is about 165,000,000. The hardwood is largely oak used for framing.

## CONSUMPTION OF SOFTWOODS BY SPECIES AND ITEMS

Figures collected by the Forest Products Laboratory in 1924 and covering 26 per cent of the industry indicate that softwoods are used in freight-car construction in the following proportions:

	Per cent
Southern yellow pine-----	54
Douglas fir-----	43
Miscellaneous-----	3

The lumber consumed may be broadly classified as follows:

	Per cent
Square-edged lumber-----	46
Worked lumber-----	54

The first item is largely framing; the latter includes decking, sheathing, lining, etc.

## CONSUMPTION BY GRADES

The softwoods used in car construction are bought in the following (or equivalent) grades:

	Per cent
No. 1 Common-----	48
C & D Selects-----	28
B & Better-----	20
No. 2 Common-----	4

## LENGTHS PURCHASED, AND CUTTING SIZES

Eighty per cent of the concerns canvassed report that they buy no lumber in lengths under 8 feet, except car roofing. The remaining 20 per cent purchase a proportion of certain items of framing, such as fillers and "cripples," in short lengths.

According to the replies, roofing of all types constitutes 8 per cent of the lumber bought for car construction and repairs. Because of the advent of the metal roof, only 41 per cent of the lumber is bought in 5-foot lengths.

So wide is the variation in the types of box cars and in construction methods that it is impossible to select any one type as standard. As a specific example of material used, however, the following bill, which applies to a double-sheathed box car of 80,000 pounds capacity and calls for 5,000 feet of lumber, may be of interest:

	Lengths purchased	Per cent
Framing-----	12 feet to 41 feet 3 inches	27.4
Flooring-----	9 feet 6 inches	24.0
Sheathing-----	9 to 10 feet	21.0
Lining-----	8 feet 9 inches to 18 feet	15.0
Roofing-----	12 to 18 feet	10.4
Running boards-----	11 feet 3 inches to 18 feet	2.2

#### POSSIBLE EXTENSION OF USE OF SHORT LENGTHS

Owing to changes in types of construction, the elimination of 5-foot roofing lengths, and the substitution of metal framing for wood, it appears doubtful whether the use of short lengths in car construction can be materially increased. Estimates as to the mechanical life of box cars vary considerably, but the average figure given is about 17 years. Parts subjected to the greatest wear and exposure, such as decking and roofing, will probably require replacing two or three times during that period. Since about one-third of the cars now in use are of the all-wood type, considerable quantities of lumber for repair work are assured to be in demand for years to come.

Some companies now purchase a part of their framing material in short lengths or multiples of short lengths. Taking as an example the box car previously considered, it appears that 23½ per cent of the framing is used in lengths less than 8 feet. This amounts to about 6½ per cent of all the lumber in the car and includes 19 separate items, such as headers, "cripples," fillers, braces, grain strips, door stiles, and running-board saddles. The footage of individual pieces varies from one-third of a foot to 7 feet.

#### SOURCES OF LUMBER

The lumber used in the construction of freight cars is purchased from the following sources and in the following proportions:

	Per cent
Mill-----	44
Wholesalers and jobbers-----	56

#### MILLWORK

Products included under millwork are sash, doors, window and door frames, interior trim, and ready-assembled fixtures such as book cases, cabinets, and breakfast nooks. On the west coast numerous millwork factories are operated in connection with sawmills. In the larger cities throughout the country a considerable amount of millwork is made in plants connected with lumber yards. Also, in

the Middle West especially, there are numerous large independent plants.

#### LUMBER REQUIREMENTS

The manufacture of millwork is one of the largest wood-using industries, its consumption of softwoods alone being well in excess of 1,000,000,000 feet annually. The lumber demanded for millwork is of two general kinds, namely, softwood shop lumber, for use principally in sash and doors, and upper grades of hardwoods or softwoods, used for trim, built-in fixtures, etc. Shop lumber is a class of material intended primarily for cutting up into smaller clear pieces. The lumber classed as trim is also cut up, though to a less extent, since it is bought in narrower widths than the other materials and used in longer lengths. In factory sawing operations the first object is to obtain whatever long cuttings are needed. Short cuttings are produced as an unavoidable by-product, part of which can be used for sash and for core blocks. In trim, cuttings down to 3 or 4 feet long have some value.

#### USE OF SHORT LENGTHS

"Cut stock" from shop lumber is made in considerable quantities at sawmills, and a few manufacturers of standard sash and doors buy as much as 50 per cent of their lumber in this form. On the other hand, the manufacturer of millwork specialties can not foresee the demands of his trade and must consequently buy his lumber in lengths that will meet any probable requirement. Among shorts sometimes bought in specified lengths are stair risers and treads, head casing, window casing, and short trim. Such items are specified in lengths from  $2\frac{1}{2}$  to 6 feet.

Random-length shorts should not be confused with material which is cut to size for a given purpose. Some of the disadvantages charged against random-length shorts are extra-handling costs, added waste, and excessive space required for piling. As an offset to such disadvantages buyers demand considerable differentials in price.

Each plant engaged in the production of millwork has its own problems, and opinions vary widely regarding the practicability of using short lengths. Offsetting the concerns that report buying considerable quantities of their shop lumber in ready-cut stock are others that buy none at all and consider its use inadvisable. In the course of this survey a large number of millwork producers were asked: "What percentage of your shop lumber is bought in short lengths?" The figures given in reply varied from 0 to 40 per cent, the average being 6.5 per cent. The same question was asked regarding trim, and the figures received varied from 0 to  $33\frac{1}{3}$  per cent, the average being 6 per cent.

#### WOODENWARE

The term woodenware covers a very wide range of products—pails, tubs, clothes racks, bowls, stepladders, hose reels, churns, ironing boards, bread boards, and the like, together with some classes of turnings. From the standpoint of volume of lumber consumed, the most important items are the first two named—pails and tubs.



## LUMBER CONSUMPTION

Woodenware manufacture is one of the larger wood-using industries, consuming about 100,000,000 board feet of softwoods and more than twice that quantity of hardwoods. The industry is considered very briefly here because it offers a relatively poor field for softwood shorts.

The properties required in the raw materials naturally vary according to the purpose for which the product is intended. For butter tubs a tasteless and odorless wood is necessary, whereas for fish pails and candy pails the requirements are somewhat less exacting. A light color is dictated in catering to long-established trade demands. It appears that white pine is more commonly used than any other softwood and that spruce comes second, followed by southern yellow pine, cypress, cedar, redwood, hemlock, and fir, in the order named.

## USE OF SHORT LENGTHS

Materials for the covers and bottoms of pails or tubs are sometimes bought in short lengths. The lengths required for these parts range from 8 to 18 inches, and the most common thicknesses are three-eighths and five-eighths inch. The staves vary considerably in dimensions. For the most common sizes of pails and tubs their length falls within the limit of 11 to 15 inches. Staves are usually sawed direct from bolts in making the smaller stock products, but the longer and thicker staves for ice-cream tubs are sometimes made from short clear lengths of softwoods.

Established manufacturing practice seems to discourage the introduction of ready-cut shorts on any large scale. Owing to the lateral curvature of staves considerable waste would arise in making them from lumber, whereas by the use of special saws they can be cut directly from bolts with a minimum of waste. Moreover, it is said to be cheaper to handle and utilize bolts than very short pieces of lumber.

## AUTOMOBILE SHIPMENTS—DOMESTIC

It is not necessary to box or crate automobiles and trucks for domestic shipment. Nevertheless approximately 60,000,000 feet of lumber is used yearly for the blocking, bracing, and supports necessary to hold the partly assembled machine in place in the freight car. The most common method of shipping requires the use of "horses" made of 8/4 dimension. The horse is an A frame with two or three legs, according to the weight of the machine for which it is intended, and carries the load of an axle or other part at its apex. It is set in the angle of the floor and wall of the car in a leaning position and is secured to the wall by a side brace. Usually one leg is about 10 feet long and one or two about 6 feet. The cross-pieces and side braces are shorter.

Southern yellow pine is the wood chiefly used, though there is no reason why other good structural woods available in quantity should not prove entirely satisfactory. The usual sizes bought are 2 by 4, 2 by 6, and 2 by 8 inches, and a small quantity of 1-inch lumber. Short blocks of heavier material are used for blocking and footing.

## SHADE AND MAP ROLLERS

The shade and map roller industry, which includes also such products as curtain rods and shade slats, is largely localized in the Northern and Eastern States. The general opinion in the trade appears to be that more rollers are being made now than formerly, but that wood is barely holding its own in their manufacture. In other words, the expansion of the industry is taking the form of an increased output of metal articles.

## METHOD OF CONSTRUCTION

In the manufacture of wooden rollers, squares are turned to the round form on the lathe and are then bored to receive the spring. The finished roller is sometimes made of two short lengths spliced together.

## LUMBER CONSUMPTION

It is estimated that the manufacture of shade and map rollers requires 68,000,000 board feet of lumber yearly. Only about 8 per cent of this footage consists of hardwoods, and most of this 8 per cent is the softer ones, such as gum and basswood.

The principal properties required are ease of working, stability of form and size, and resistance to splitting. The trade has long associated light color with the other preferred properties of the wood, although in itself the color would be a very minor consideration. The woods commonly used are eastern white pine and western yellow pine, together with small quantities of spruce, fir, and southern yellow pine. Much of the lumber is bought in the form of squares cut to length. Thicknesses range from 1 to 2 inches, the former comprising about three-fourths of the total and the quantities used decreasing as the thickness increases.

## CUTTING LENGTHS

The finished rollers vary from 16 inches to 6 feet in length, most of them being less than 4 feet long. Thus they offer a possible outlet for short-length lumber of certain qualities and species.

## PATTERNS AND FLASKS

The use of short lengths for patterns and flasks was given only incidental attention in this study, but for the sake of completeness it is thought best to outline the conditions observed. Patterns and flasks are related but by no means identical products. They are made by nearly all large metal-working companies for their own use. In addition there are independent pattern shops in all industrial centers. The use of wood is being gradually narrowed down to temporary work, whereas metals are being used more and more for permanent equipment.

## LUMBER CONSUMPTION

It is estimated that the manufacture of patterns and flasks consumes 21,000,000 feet of lumber yearly, of which 20 million feet are softwoods.

Requirements for pattern work are very exacting, stability of form and size under adverse conditions and a high degree of workability being essential properties. In some shops thick, wide, practically clear lumber is demanded; in others cutting grades are considered satisfactory. As a rule the cuttings are clear or practically so, and are prepared in an infinite variety of sizes and shapes. As far as cutting sizes are concerned, a large part of the requirements of the industry could be met with short clears or short shop lumber. The quality requirements, however, will always bar material of most species. Pattern lumber is usually a very minor purchase with large metal-working concerns, and it would probably be easier to interest the independent pattern maker in the use of shorts. For flasks lumber with small sound knots is usually considered good enough. Such lumber should possess to a reasonable degree the properties of holding its shape, strength, durability, and resistance to wear.

#### GRAIN DOORS

Grain doors are used in shipping loose grain in box cars. They constitute a large and distinct use for low-grade lumber. Railroads running through the grain-producing regions require millions of board feet of lumber yearly for this purpose.

Grain doors are often made at the mill, sometimes by large city dealers, and less commonly by the railways themselves. They are usually 7 feet long, 20 inches wide, and made of two thicknesses of 1-inch lumber. Some railways use grain doors 6 feet long. It should be noted that the method of construction with two 6-inch cleats on one side, as is shown in Figure 11, permits the use on that side of lengths 1 foot shorter than on the other side. Low-quality lumber, either hardwood or softwood, is acceptable, provided the finished door is reasonably strong and grain tight. Two or more boards may, of course, be used to make up the finished width of 20 inches.

#### FENCES

Although the use of wire for fences has greatly increased in recent years, wooden fences still deserve mention as an outlet for shorts. There is no way of estimating the total quantity of lumber that goes into fences annually, but it must amount to millions of board feet. There are two main types of fence of interest in this study—the picket fence, which is largely a factory product and calls for practically clear material, and the tight-board fence constructed in situ, for which sound knotted stock is generally satisfactory. There is of course no standard height for board fences, but they are very commonly 5 feet high. Aside from large distributors, it is probable that the only the largest consumers, such as railways, would be in a position to buy short-length fencing material direct from the producers.

#### PIANO BOXES

Piano boxes offer an outlet for about 25,000,000 feet of common lumber yearly, of which it is estimated that softwoods comprise 20,000,000 feet. Although its quality varies somewhat, the lumber is mostly of merchantable or box grades. The principal species



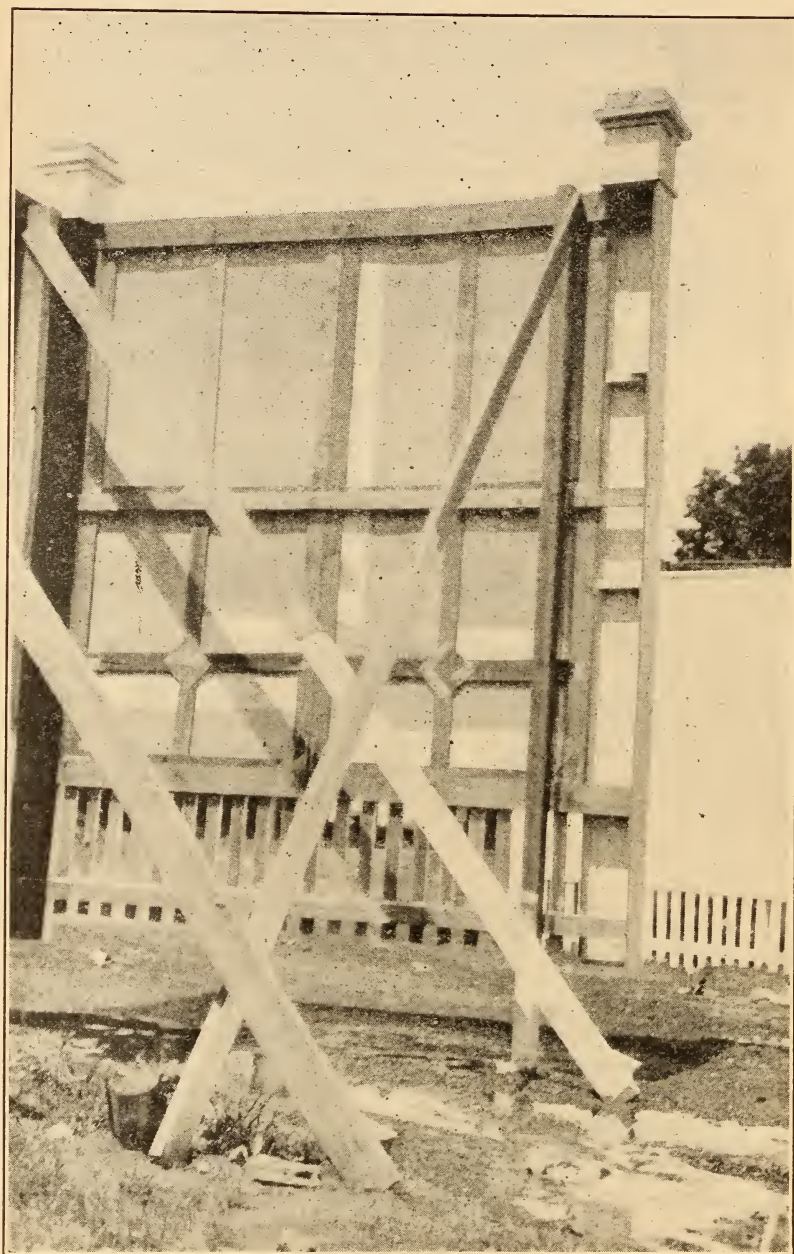


FIG. 11.—Grain doors for box cars, a use for short lengths of low-grade lumber. Railways running through the grain-producing regions frequently buy several million feet apiece yearly for this use. The doors are usually 7 feet long, 20 inches wide, and made of two thicknesses of  $\frac{4}{4}$  lumber

used are eastern spruce and eastern white pine. Hardwoods are used to a less extent. The thicknesses are  $\frac{4}{4}$  and  $\frac{5}{4}$ , mostly the former.

Cutting lengths depend somewhat upon the design of the box. Some are as short as 2 feet, others as long as 8 feet, but the usual range is from 4 to 6 feet.

The commonest practice is to make up the box faces and ends at sawmills and ship them in that form to the piano factory, where they are assembled as needed.

#### CAR RACKS

Meat packers, in shipping tubs of lard, boxes of smoked meats, etc., use large numbers of racks in the refrigerator cars to hold the goods above the floor and thus assure a better circulation of air. A typical rack is made of 2 by 4's 2 feet long, laid on edge at 2-foot intervals and latticed over with 8-foot strips 1 by 4 to 1 by 6 inches in size. The finished rack is then 2 feet by 8 feet and runs crosswise of the car.

Car racks offer an outlet for dimension in 2-foot lengths or multiples. The market is practically confined to a few large companies and can be reached with comparative ease.

#### SCALE BEAM BOXES

The manufacture of heavy platform scales requires only a few million feet of lumber yearly, but offers a fairly definite outlet for short lengths.

Most of the lumber entering into their construction is  $\frac{8}{4}$ -inch and thicker material used for the framing and platforms, which does not concern the present discussion. The material of interest here is that used in the scale beam box. This is the upright box or housing containing the graduated arm on which the weight moves, located alongside the platform. Ordinarily, plain dressed lumber is used for the ends, cap, and base of the box, whereas the front and back are made of ceiling or partition. Southern yellow pine, white pine, and Douglas fir are the woods reported. Although the lengths required for scale beam boxes are all under 6 feet, the only short lumber reported as being bought as such is  $\frac{5}{4}$ x4-inch Douglas fir partition.

The principal properties required are durability, good appearance, and stability.

#### FACTORY TRUCKS

Factories in nearly all lines of production use small trucks for moving material in various stages of manufacture. Trucks of the several styles are usually simple in construction and are produced in all parts of the country where the manufacturing demand warrants. A very common kind is the "lift truck," in which only the platform is of wood. Each truck may have several interchangeable platforms. The platforms are very simple in construction and often are made in the plant where they are to be used.

## LUMBER CONSUMPTION

Owing to the conditions under which factory trucks are manufactured there is no definite basis for an estimate of the quantity of lumber consumed. There is no doubt, however, that the requirements amount to several million board feet yearly. From inquiries at a large proportion of the plants it appears that half of the consumption, or perhaps slightly less, is softwood lumber. Long-leaf pine is more commonly used than any other softwood. Some spruce and small quantities of white pine are reported. Thicknesses purchased range from 4/4 to 8/4 inches and lengths from 8 feet upward. Thirty-eight per cent of the lumber is bought as dressed square-edged material and 62 per cent as rough stock. The only item reported as being bought in short lengths is long-leaf pine cut to size. It is said to be very satisfactory.

## CUTTING LENGTHS

Few of the concerns canvassed have had any experience with short lengths or seem to have seriously considered their use, although it is safe to say that practically all the lumber used in factory truck construction is cut into lengths of less than 8 feet. It seems probable that companies doing a considerable volume of business in a few sizes of trucks, or large industrial plants making their own truck platforms, would be able to meet a large part of their lumber requirements with ready-cut shorts.

## SOURCES OF LUMBER

In the cases reported, the lumber was purchased from the following sources and in the proportions indicated:

	Per cent
Mills.....	77
Wholesalers.....	21
Retailers.....	2

## NONWOOD INDUSTRIES

Aside from the wood-fabricating industries proper there is the much larger number of industrial concerns that use wood incidentally or as a raw material of relatively minor importance. Their lumber requirements of course vary with the size of the plant, the product manufactured or handled, and local conditions. In the aggregate they undoubtedly constitute a very large market for lumber.

To afford an idea of the characteristics of this market, the kinds, grades, and sizes of lumber used, and the purposes served, information was obtained from some 50 large industrial concerns with which the Forest Products Laboratory had had previous contacts. This information, briefly presented in the following paragraphs, has to do chiefly with the manufacture and marketing of machinery, packing-house products, hardware, farm implements, scientific supplies, groceries, dry goods, and glass.

The bulk of the lumber required is used for such shipping purposes as boxing, crating, blocking, or skids. The outlets offered for



short lengths of lumber worked to patterns are of minor importance as compared with those for square-edged dimension and boards. In the partial canvass that was conducted a normal total consumption of 330,000,000 feet yearly was reported, of which 210,000,000 feet was softwood lumber. The following data apply only to the softwoods consumed.

#### USES OF SOFTWOODS

The reported uses to which softwoods are put by the industries using wood only incidentally are divided into four main classes, as follows:

	Per cent
Boxes-----	71
Crates and blocking-----	15
Repairs, construction, and plant maintenance-----	11
Manufacture of wooden products-----	3

#### BOX MATERIAL

Of the total box material 48 per cent is bought in the form of shooks. The remaining 52 per cent is bought as stock lumber, in the following forms and proportions:

	Per cent
Rough-----	45
Dressed, square edged-----	51
Dressed and matched-----	4

According to the data furnished, the thicknesses of the boxing used may be arranged in order of importance as follows: 4/4", 8/4" and thicker, 3/8", 5/8", 5/4", 1/2", 6/4", 3/4", 1/4", and 3/16". Much of the 4/4 and thicker lumber is resawed at the consuming plant.

#### CRATING AND BLOCKING MATERIAL

Material of standard 8/4 thickness comprises 11 per cent of the lumber used for crating, blocking, and bracing. The quantity bought in short lengths is almost negligible. Four-quarter material comprises 55 per cent of the crating lumber used. Of that amount 32 per cent is bought in lengths of less than 8 feet. Four-quarter material is bought in the following forms and proportions:

	Per cent
Dressed-----	68
Rough-----	29
Worked to pattern-----	3

Scarcely any shipping lumber is bought in thicknesses greater than 8/4 inches, and since the percentages bought in 8/4 and 4/4 thicknesses are reported as 11 and 55, respectively, the inference is that the remaining 34 per cent is thinner than 4/4.

#### MAINTENANCE AND CONSTRUCTION MATERIAL

Practically all lumber used for maintenance and construction purposes may be divided into two classes: 4/4 boards, which form 27 per cent of the total, and 8/4 and thicker dimension, forming the remaining 73 per cent.

## MATERIAL USED IN MANUFACTURE

Manufacturing processes involving the use of wood by these industries require much less material than is used for boxes, crates, or maintenance work. Considerable diversity appears in the kinds, sizes, and qualities of the lumber purchased and uses to which it is put. Probably the most important single use is in patterns and flasks. Also, there are numberless small wooden parts and accessories in machines and other products. The reports indicate purchases of lumber for such purposes in the following forms and proportions:

	Per cent
Rough-----	60
Dressed square edged-----	37
Worked to pattern-----	3

## SOURCES OF LUMBER

The lumber consumed by the representative concerns of this group is purchased from the following sources in the proportions shown:

	Per cent
Mill-----	67
Wholesalers and jobbers-----	26
Retailers-----	7

## PURCHASE OF SHORT LENGTHS

The only item of short lengths bought in any considerable quantity is box shooks. In fact, the vast majority of the companies reporting state that aside from shooks they buy no short lengths whatever. The rest buy shorts only in small quantities, of which a considerable part is crating stock and dimension blocking and bracing for use in shipping machinery.

## POSSIBLE EXTENSION OF USE OF SHORTS

Aside from box shooks and crating, both of which are discussed in a preceding section, the most promising outlet for shorts is in blocking, bracing, and skids for shipping machinery. It is not uncommon for manufacturers of machinery to use several hundred thousand feet of 2 by 4's and larger dimension yearly for shipping purposes. Short dimension material would lend itself admirably to such requirements, and the market appears well worth cultivating.

## MINOR OUTLETS FOR SHORT LENGTHS

The products discussed in the foregoing sections are believed to include all of the larger actual or prospective outlets for shorts. There are, of course, a large number of smaller items that merit some consideration but can not be treated in detail here, such as ironing boards, stove boards, battery boxes, drawing boards, shovel-boards, toilet tanks, cloth boards, core stock, and windmill vanes.

TRADE ASSOCIATIONS CONCERNED IN THE PROBLEM OF SHORT LENGTHS

Manufacturers of many wooden products are associated in trade organizations, and it is probably through such bodies that the best contacts with the industries may be had. The lumber manufacturer or dealer must of course sell his own wares, but association officials can readily assist him, at least to the extent of furnishing membership lists. The following partial list of associations concerned in the manufacture of wooden products for which short lengths are required is included as a matter of information:

Organization	Address
American Incubator Manufacturers' Association-----	Box 1636, Lincoln, Nebr.
American Washing Machine Manufacturers' Association-----	10 South La Salle Street, Chicago, Ill.
Associated Woodenware Manufacturers-----	Fitchburg, Mass.
Automobile Body Builders' Association-----	1819 Broadway, New York City.
Casket Manufacturers' Association of America--	308 Odd Fellows' Temple, Cincinnati, Ohio.
National Association of Box Manufacturers-----	844 North Rush Street, Chicago, Ill.
National Association of Farm Equipment Manufacturers-----	608 South Dearborn Street, Chicago, Ill.
National Commercial Fixture Manufacturers' Association-----	517 Murray Building, Grand Rapids, Mich.
National Ladder Manufacturers' Association--	6 North Michigan Boulevard, Chicago, Ill.
National Refrigerator Manufacturers' Association-----	Sheppard Building, Grand Rapids, Mich.
Pacific Coast Garage Door Manufacturers' Association-----	616 Spalding Building, Portland, Ore.
Railway Car Manufacturers' Association-----	61 Broadway, New York City.
Southern Sash, Door, and Millwork Manufacturers' Association-----	Candler Building, Atlanta, Ga.
Toy Manufacturers of the United States of America-----	Fifth Avenue Building, New York City.
Western Planing Mill and Woodworking Association-----	616 Spalding Building, Portland, Ore.
Wholesale Sash and Door Association-----	28 East Jackson Boulevard, Chicago, Ill.



# ORGANIZATION OF THE UNITED STATES DEPARTMENT OF AGRICULTURE

JULY 8, 1926

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This circular is a contribution from

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